Vol. 73. No. 3

MARCH, 1942

PUBLIC WORKS

Streets and Highways • • • Water Works
Sewage Disposal • • • Airports

Relocated 36-inch cast iron pipe at Reading

READING, PA. wanted the new highway even if it meant abandoning a seven-mile-long water main which had to be re-routed. The cost of a new cast iron line would have been approximately $350,000.

Fortunately, the original line was cast iron. It could be salvaged and re-used. It was. Seven miles of 30- to 40-year old cast iron pipe in 24-inch, 30-inch and 36-inch diameters were taken up, reconditioned and re-located. The taxpayers of thrifty Reading were thereby saved a large amount of money. This is a stri example of the salvage and re-use value of cast iron p But there are numerous other examples in the files of Cast Iron Pipe Research Association.

It is impossible to foretell future requirements or po lation shifts in metropolitan cities but any public off can be sure that, when water or sewer mains must be ab doned or re-routed, the pipe can be salvaged or used, *if it is cast iron pipe.*

Pipe bearing this mark is cast iron pipe.

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If you require more water, arrange for additional wells and pumps without delay. Better call in a Layne engineer. He will cooperate with you in planning your additional water supply so as to use the minimum amount of materials essential to war work, yet give you an adequate, efficient and long lived installation. Layne wells and pumps are designed for your requirements regardless of size. They are noted for their high efficiency and trouble free service. They are serving all types of industries, municipalities both large and small, army and navy needs, training camps, flying fields and munitions plants.

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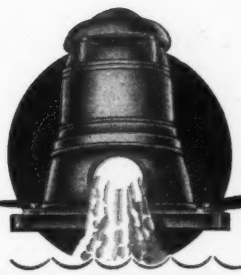

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The Editor's Page

Provide an "Automatic Personnel" for Emergencies

We wish to call to the attention of all water works superintendents, and others in charge of public utilities, the following excerpt from a report by the Committee on Water Works Emergencies of the New England Water Works Association.

"The important element in *any* emergency is a well defined plan of action (when and how), all without having to think it out over a telephone at 3 a. m., facing a thermometer with its mercury either out of sight or lifting the roof off, as is usual when emergencies corner you. The other important consideration is the class-room drilling of key employees to know at once which 'boat' they are to man when the call comes; what orders to give when an excited or untrained crew is turned out; and where to locate the materials required—all while 'Hell's-a-poppin'.'

"In water works practice, we depend a lot on automatic devices and equipment. What is most needed in emergencies is 'Automatic Personnel,' and this can be had only through the question and answer 'shooting' and practice drills to establish who does what, when, and how. In emergencies, questions and hesitation and mismoves should be considered in the same category as the tubercles that prevent automatic valves from functioning when their operation is most essential.

"Someone has said, in connection with catastrophes or emergencies, that the first thing to do is NOTHING. That may frequently apply also in water service; but the second thing to do is SOMETHING, but making certain that this 'something' is the right thing.

"The public has little tolerance for leaders who find themselves unprepared to lead, or lacking a dependably functioning organization with requisite equipment when emergencies come."

Keep the Homes Fires Burning

North, south, east and west, the war is the all-important matter. Travel by car (if your tires last) from Maine to Miami over the entire length of U. S. Route No. 1, and you will not at any time be an hour's distance from reminders of that fact — ship yards; plants for fabricating tanks, planes and equipment of various kinds; camps for the temporary housing of hundreds of thousands of men, and trains carrying them to unknown destinations. The tempo of this will continue to increase. The war and these concentrated efforts will last for a year, probably two, possibly five; but it will end some time—it must, for in time everything needed to carry on at the present pace, except courage and determination, will be exhausted.

And when it ends, hundreds of thousands of weary men will return home. And they must find homes in which they can again take up a life in which civil rather than military matters are all-important. Homes in villages which for months or years had had few active men to keep them going, fewer tax dollars to spend, and no priorities; on farms the roads to which were not military essentials. But these homes must be ready for them. The water works must be kept up, ready to furnish all with abundance of safe water. The sewerage system must be capable of handling the increased volume of sewage. The "non-essential" roads will again be found to be very essential.

The officials in charge of these utilities, too old themselves for the draft and shorthanded because many of their assistants were not, have a duty to keep these utilities from depreciating (on an appropriation that is far from adequate) which is as important for the future of their country as any that is performed by those directly connected with war operations. They may have to revive some old methods for the lack of materials necessary for the new; patch up old machinery because they cannot get new; devise methods for saving labor without new labor-saving appliances.

But it must be done. And those who do it will have as much right to feel a pride in their service to their country as though they had been "over there." And those who are entrusted with this duty and fail to perform it to the best of their ability will be deserving of the severest criticism.

100-Year Material in 10-Year Projects

Discussing "Water Works Operations Under Emergency Conditions" before the New England Water Works Association recently, Harry E. Jordan said: "There is much talk of use of substitute materials or materials giving a shorter time of useful service than the standard specification materials. . . . Regrettably, much high-grade long-life specification material has gone into army camps and the like. Regrettably also, civilian long-term requirements are now being shunted off into the inferior or substitute material. There are many useful substitute materials. Many can be used in water supply. . . . Water plants can again get along with many things they formerly found satisfactory, which have, in recent peace-time years, been displaced by newer higher-grade materials. But there is every reason why temporary military projects should also be adjusted to the same pattern. There is simply no sense in the laying of heaviest grade pipe in a temporary training center and allowing permanent public water supply only secondary, light-weight, or short-lived material. This is a practical attitude, involving payment by 'the Public' for material used in either case. The citizens should get the most for every dollar they are having spent for them in permanent structures and services and not invest in 100-year material for use in a 10-year-life project."

Defense (should it not now be offense?) projects admittedly have first call on men and materials; but it is unreasonable to use unnecessarily long-lived or otherwise expensive materials in such projects, when this compels municipalities to use materials that are uneconomically short-lived for them but would be as satisfactory as the longer lived for the defense projects.

PUBLIC WORKS Magazine . . MARCH, 1942

VOL. 73. NO. 3

A town highway, April 7, badly in need of maintenance.

Spring Maintenance of County Roads

How a Wisconsin county eliminates frost boil troubles and mud holes in gravel roads, dries the road surfaces and opens frozen culverts.

By H. B. OLSEN

County Highway Commissioner, St. Croix Co., Wisconsin

MANY of the important problems of spring maintenance (and also other kinds of maintenance) can be eliminated by proper building of the roads; or by proper snow removal, if located in the snow belt. There are, however, some problems that are unique to spring maintenance and for which we in St. Croix County have discovered and use remedies which I will attempt to explain.

In our county, two-thirds of which is covered with clay sub-soil, the most serious and perplexing problem confronting us are those break-ups commonly known as "frost boils." A frost boil is the condition that arises when the water cannot drain through the underlying impervious clay, but remains on top of it and forms a soft, springy, frozen, wet mass underneath the surface. This condition lasts long after the surface is all dry—we have known it to last through July and even into August. When the traffic gets heavy the surface cracks, and this soft, mushy mass of clay and frost oozes up through, leaving the road in an almost impassable condition. These frost boils may crop out under any kind of surfacing, including gravel, blacktop, and concrete.

In my twenty-six years of highway work we have tried several solutions to this problem, three of which have been quite satisfactory and are worth mentioning here. We started years ago trying to eliminate frost boils by digging a trench down the center of the road and putting lead-offs from it to the road ditch every 50 or 75 feet, filling this trench with rocks (varying in size from 4 to 10 inches in diameter) to within 12 inches of the top of the road and covering these rocks with rye straw, marsh hay or tar paper and filling the balance of the trench up with dirt again. This method worked fairly well, except that in time the soft, mushy soil would seep in between the rocks and stop up the drainage.

We have also used perforated pipes in the same way, 6″ pipes, the bottom half of which is perforated, being used in place of rocks and about six inches of coarse gravel put around the pipe before filling the ditch with dirt. This method also has worked quite satisfactorily.

However, I think that the best method, and the one which we have been using in recent years, is the use of sand lifts. This method works best in taking care of the entire road surface; and it is quite economical, particularly if sand is available near by. We take a construction grader and cut a trench down the center

H. B. Olsen, County Highway Commissioner.

Top—Water standing above a frozen culvert. At left, boiler connected by hose to pipe, which is pushed into outlet end of frozen culvert. At bottom, water flowing out of culvert as ice is thawed.

of the road about 20 inches deep and of a width depending somewhat on the width of the travelled road. On a county trunk highway, which is 24 feet wide, we cut the trench about 18 feet wide, fill it with sand, and then grade over the entire road the dirt which was excavated from the trench and left on the shoulders of the road. This, of course, raises the highway somewhat and the grade has to be tapered off at both ends of the trench. We dig lead-offs, which also are filled with sand, from this trench through the shoulder out to the ditch every 50 or 75 feet so as to give the water a chance to get out. This leaves only about three feet of solid road between the ditch and the sand trench, which seems to be able to drain and stay dry. We have done a considerable amount of this kind of work—in fact, we use this method in all of our county trunk highway construction work. None of the "remedy at the time" methods, a variety of which are used by numerous counties, are very satisfactory, and the best and, in the long run, the most economical thing to do is to fix them permanently with sand lifts or by thorough drainage.

Spring maintenance should begin in the fall of the year. We have found that crowning the roads slightly in the fall, during the last few patrollings, is beneficial in draining the water off in the spring and also in draining off any water that might collect during the winter from rains or thaws. This also puts most of the gravel toward the center of the road, making a good thick layer that will better carry the traffic before the road dries out in the spring.

Perhaps the most important feature in the prevention of mud holes (not frost boils), is plowing the snow to and off the shoulder of the road as far as possible. If the snow isn't pushed way off the road, the water will run down the road as the snow melts and will cause trouble. If, on the other hand, the roads are high with wide ditches, and the snow is pushed way off the shoulder, the water from the melting snow will drain into the ditches and the road will dry out with a couple of days of patrolling and good weather.

Mud holes do occur, however, and I believe that the best remedy is the use of coarse crushed gravel or crushed rock, which should be placed in stock piles in the fall. We grade out as much of the mud as possible and put on a coat of gravel heavy enough to carry the traffic. A light coat of gravel is worse than none at all, as the traffic will cut through it and push up the mud, making it impossible to drive through at all. It also keeps the mud holes from drying out. Sometimes the use of coarse hay or coarse straw or brush will get the traffic through.

The shoulders of the road constitute another important consideration. Sometimes the patrolmen are inclined to start a new ditch about a foot or two from the shoulder so as not to get sod on the highway.

(Continued on page 35)

Top—Grass and weeds blocking culvert. Bottom—Wash-out at culvert too small to handle the drainage.

Fig. 23—Dam whose position is concealed by camouflaging (at the left); at the right, view taken before camouflaging.

Protecting and Repairing Municipal Services in War Time

Part III—Protecting Waterworks Structures

By Joseph D. Lewin and M. J. Popper

Small Masonry Dams

A SOLID masonry dam would sustain relatively less damage from bombs than an earth or a rock-fill dam. The crater would be limited to about:

500 lb. bomb, 2.5 ft. deep— 5 ft. dia.
1000 lb. bomb, 5.0 ft. deep—15 ft. dia.
4000 lb. bomb, 8.0 ft. deep—25 ft. dia.

In most cases of damages at the crest, an adequate freeboard limits the loss of storage water and the consequent enlargement of damage.

Possibility of erosion at the foot of the dam caused by outflow through the break should be investigated. This is particularly important at non-overflow dams. Precautionary measures, such as heavy riprap or lining of the channel, might be advisable.

Large Dams

Since on the proper functioning of large dams might depend power, industry and water supply of important communities, such dams become strategic targets. Not only bombs, but also aerial torpedoes have to be considered. Aerial torpedoes up to 8000 lbs., with consecutive explosive charges, have been developed, which possess a devastating power.

Such torpedoes might strike the face of the dam at or below the water surface. For protecting the face, a boom with suspended torpedo net is effective. The boom can be of the standard design which is normally used against ice pressure, and should extend at least 5 ft. below the surface and the attached net at least 20 ft. An example of a typical wooden boom is shown on Fig. 22. If drums are available, rafts can be built from them. The boom cannot resist the force of a torpedo, and serves principally for the premature detonation of the missile. Therefore, the space between the boom and the dam should be sufficient to minimize the action of the explosion, and at the same time not wide enough for a torpedo to fall between the boom and the dam.

A secondary boom at a considerable distance from the dam will cause the torpedo to detonate at a safe distance. In this case, the dam will sustain no damage whatsoever. The type of anchorage of a boom should provide for sufficient play to follow changes of water level and flexibility in resisting impact of torpedoes.

A boom can be designed to serve several purposes besides holding the net. It can be used for anchoring of camouflage floats, for river crossing, or as an ice-boom to reduce ice pressure on the dam, giving it also a peace-time value.

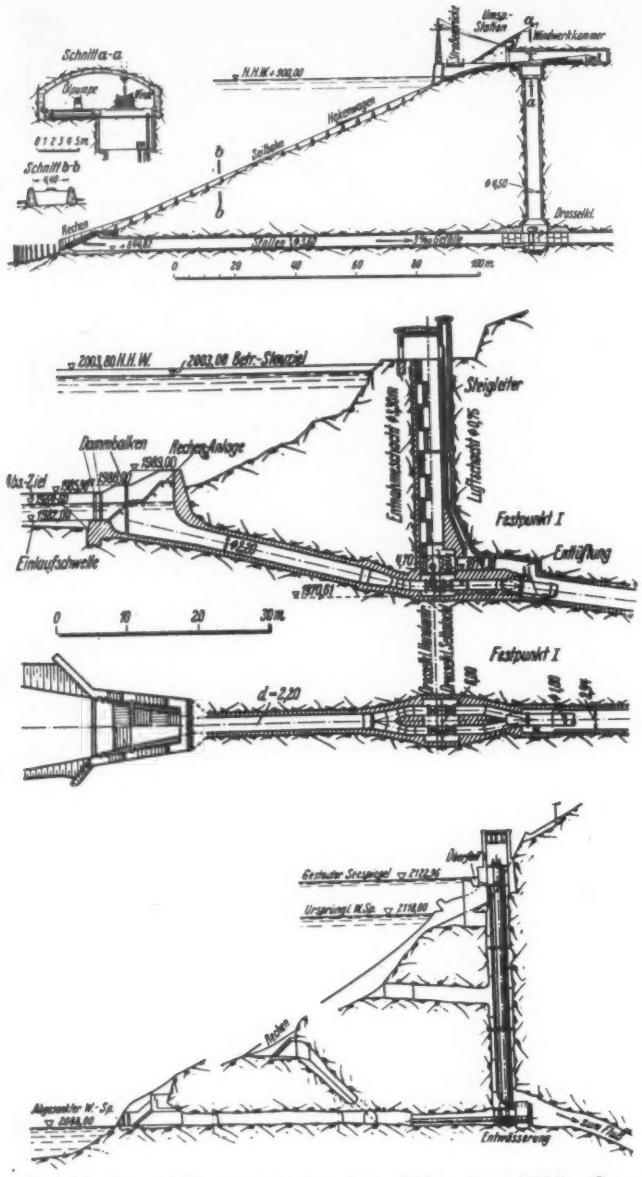


Fig. 24—Several European intakes. Top, Swiss plant. Middle, German plant built in 1929. Bottom, French plant built in 1929.

An unprotected dam of buttress type or an earth-fill dam can be considerably damaged by torpedoes or bombs. The Tirso dam, a multiple arch dam in Italy, was torpedoed at a buttress. This resulted in a six months' repair job, loss of water, and loss of head.

Any dam can be clearly seen from the air, being indicated by the water dammed up behind it. Protection of large, strategically important dams might include, in addition to torpedo booms, balloon barrages, anti-aircraft batteries and camouflaging. In planning new dams, consideration should be given to provision for future camouflaging.

There are several possibilities in camouflaging. The object might be hidden, or blended into the surroundings, and at the same time a dummy reproduced at a safe distance. Fig. 23 shows a dam before camouflaging and (at the left) after camouflaging. If camouflaging involves a reproduction of the dam, it is desirable to provide a simulated water course between the dummy and the actual river.

In preparing for camouflage, consideration should be given not only to the usual problem of form, color and texture, but also to the nature of the surroundings. Landscaping and elimination of any tell-tale objects at considerable distances constitute a large part of the cost of camouflage.

This case illustrates the necessity of keeping highways at a distance from the shore. Rerouting of highways through an adjacent valley should be considered. This will decrease the possibility of sabotage. It also illustrates that in the vicinity of a dam forests should be preserved in their natural state, since this would facilitate the concealment of the dam. The cost of dam camouflaging is high, because of the large areas involved. The illustrated camouflage, including landscaping, costs over $600,000, which does not include the additional cost of condemnation or appropriation of properties.

Proper zoning and restrictions of prominent structures and deforestation in the vicinity of strategic objects should be given serious consideration.

Intakes

In general, intakes are relatively less vulnerable. In a well supply, the wells are widely spaced for greater efficiency, and this spacing makes them less vulnerable to any considerable damage. If the supply is based on lakes or rivers, two or more intakes are desirable and should be spaced sufficiently far apart.

Intakes for long conduits are usually monolithic structures, and are quite vulnerable because of various castings and gates. In central Europe, there is a tendency toward full protection of controlling parts of such intakes.

Fig. 24 illustrates several European intakes. In the Swiss plant the gates are set far back in the tunnel, and the lifting equipment is well protected in the special tunnel on top.

Such underground intakes are also economical in peacetime if the reservoir has large fluctuations and if the banks are gently sloping. In this case, an alternate would be an intake tower, which is expensive, is subject to earthquakes and ice pressure, and may require an elaborate bridge. An underground intake, therefore, may be an economical solution. However, if the fluctuations are small or if the slopes are very steep, and no large approach excavations are required, an exposed intake may be desirable. Often the rock protects such an intake from aerial bombardment, as is the case in narrow canyons out West.

Conduits

Where the water source is at considerable distance, a conduit is required, presenting a long unprotected stretch on whose functioning might depend the entire

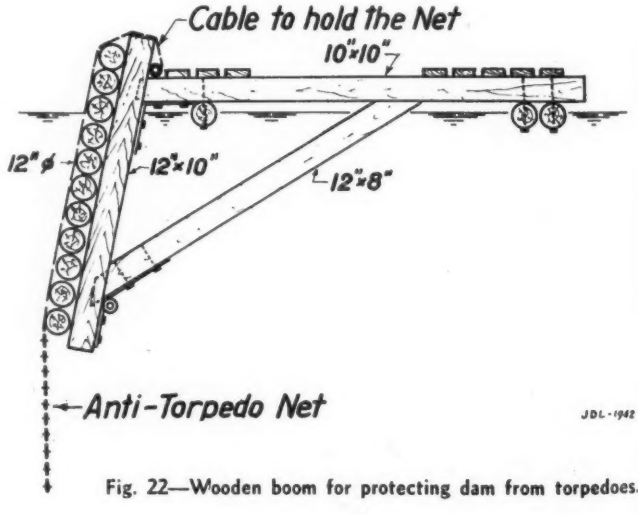


Fig. 22—Wooden boom for protecting dam from torpedoes.

water supply of a community. Disregarding aerial bombardment, policing a long conduit requires an extensive force in addition to special lighting and eventual fencing. In Germany, one guard is provided per 100 ft. of pipe line. But even such precautions would not effectively keep out determined saboteurs. Exposed conduits are especially vulnerable.

Treatment and Pumping Facilities

Communities having two or more plants should have them spaced well apart. A concentration of facilities might not necessarily be an economical arrangement. In many cases a wider distribution of the same facilities would provide improved safety conditions at the same or nearly the same investment.

Bypassing and Bombproofing

Every plant should have provisions for bypassing any part of it or even the entire plant. The controlling valves for such bypassing are vital points and should be well protected. If necessary, valve chambers should be well buried. Any pipe connections to such chambers should be flexible and safe against vibrations and earth shock.

Provision should be made for shockproofing all the important connections, piping, etc. Use of flexible couplings and connections might be considered.

If, for any reason, burying is inadvisable, the possibility of a bombproof double-shell structure should be investigated. Such structures can be made safe against direct hits of the heaviest bombs. The necessary dimensions, as given by C. W. Glover are as follows:

Size of Bomb	*Dimension "T"*
110 lb.	3′ 6″
220 lb.	4′ 0″
660 lb.	5′ 6″
2200 lb.	8′ 6″
4000 lb.	10′ 6″

Fencing and Lighting

To protect against acts of sabotage, the treatment and pumping plants should be well guarded. The police force should not only be adequate, but also equipped with the most modern devices and trained for this type of service. The nearest office of the Federal Bureau of Investigation should be consulted, as to the adequacy of the force and their equipment.

To facilitate guarding, the plant should be well fenced. However, fencing should not be considered a protection in itself. Because the saboteur can be active during periods of low visibility (foggy, or rainy night), normal fences could be cut and the grounds entered without being noticed by the guards. Fencing could be improved by use of electrical or mechanical control and warning devices. These precautions can be basically divided along the following principles.

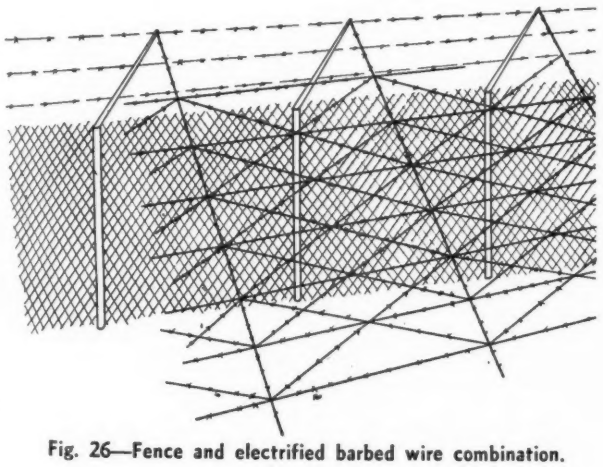


Fig. 26—Fence and electrified barbed wire combination.

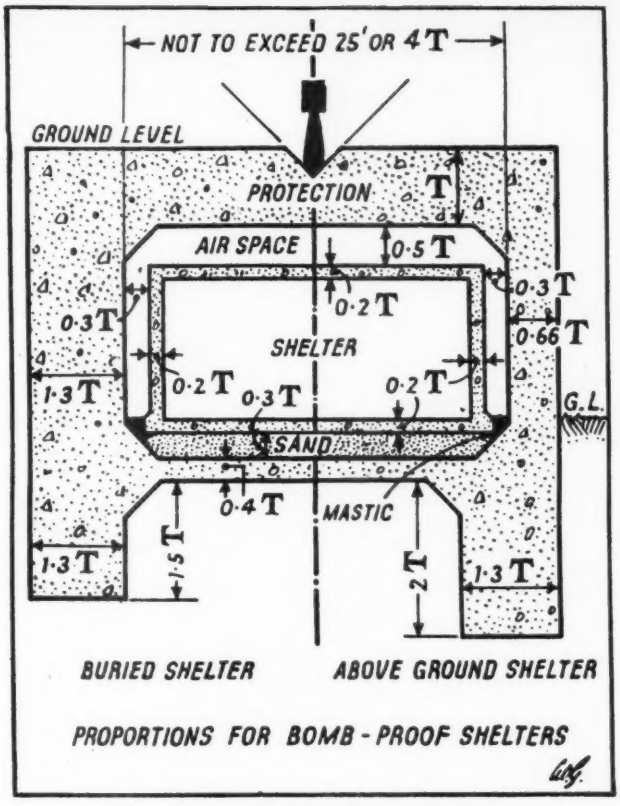


Fig. 25—Section of bomb-proof shelters.

1. Charging the fence with low potential. The posts are insulated from the ground. Any contact with the fence results in drop of potential and in consequent alarm. This method is of particular advantage in populated sections, since the low voltage will not harm any one coming in contact. However, it is sensitive to weather changes and operates under considerable difficulties during rain, snow and dense fog—when it is most needed. Because of its sensitivity, falling branches or roving animals will cause false alarms.

2. Charging the fence with high voltage. The voltage will be fatal to innocent people, but saboteurs would approach such a fence with the necessary precautions. Therefore the method can be considered of little value.

3. Use of photo-electric cells (also called electric eye). The cells should be spaced preferably 50′ to 75′ apart, but not more than 100 ft. If a visible light beam is used, the cells are sensitive to rain, fog, snow, and the system might be ineffective. Furthermore, the light beam will be visible to the trespasser. The Germans used the invisible part of the light spectrum. Regardless of type of light, at least two beams in parallel should be provided, so as to minimize the possibility of false alarm.

4. The newest wiring system is based on the principle of radio-activity, and has been developed in the United States.

5. Fencing can be rendered more effective by placing in front or back of the fence a series of barbed wires electrically charged and insulated. When cut or tampered with, a signal will locate the point of disturbance.

6. Mechanical or electrical warning devices con-

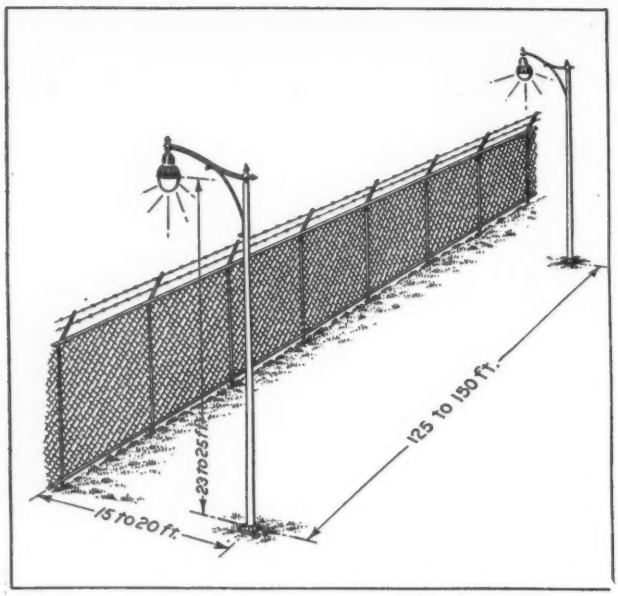


Fig. 27—Recommended method of fence lighting.

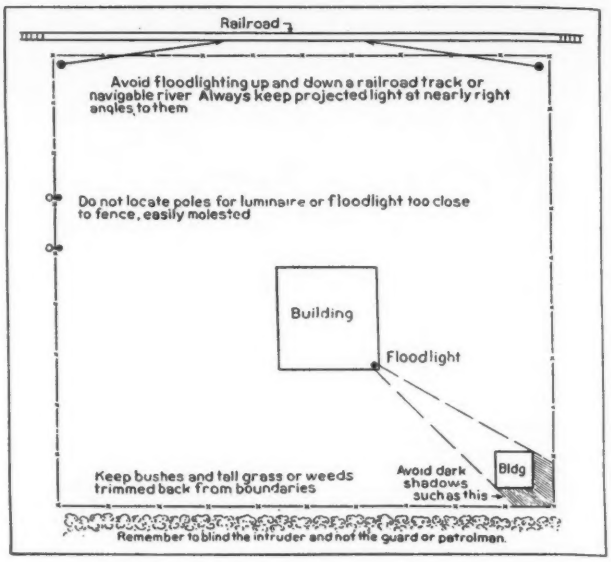


Fig. 28—Things to avoid in protective lighting.

cealed underground usually are not very effective, because of difficulty of maintenance, inspection and concealment.

Further facilitation of guarding fences is protective lighting, which permits the guard to observe the fence and approaches and at the same time to remain in the dark and be unseen by trespasser. Lighting should be applied only to fences which are guarded; otherwise the expense is not warranted.

The basic principles of protective lighting are:

1) Lighting should be applied from within the enclosure.

2) Wiring should be protected, preferably kept underground.

3) Wiring should be flexible to damages; if fed by city power, at least two separate connections to trunk lines are needed. If necessary, an emergency power plant should be installed on the premises.

4) Light beams should overlap, so that if one unit is damaged, the field is lighted by adjoining light sources.

5) Lights should be kept at a distance from the fence, 50 to 70 ft. inside, otherwise they can be reached by saboteurs.

6) The light intensity on the vertical face of fence at the period of low visibility should be about 0.1 foot candle.

Dog Tours Half-Mile of Sewer

In Sheboygan, Wis., a year-old springer spaniel suddenly disappeared below the surface of Lake Michigan while romping at the water's edge. Investigation revealed that the pup had been drawn into a submerged intercepting sewer manhole, the cover on which had been broken. Racing to the sewage treatment plant, the dog's master recited his story to Superintendent Jake Klein, who immediately dispatched two men to the screen room to watch for the dog while two others went to an emergency pumping station on the sewer above the plant. When a manhole cover at the latter point was raised, there was the spaniel—weak, bedraggled and whimpering as he clung to the iron ladder. The rescue was quickly effected and Duke was restored to his owner, little the worse for his half-mile, 30-minute tour of the intercepter.

In New Jersey a few weeks ago a cow traversed several miles of a large sewer. What animal will next make the news column via the sewer?

Materials Used for Culverts and Subdrains

The following tabulation shows the materials used by the counties in the various states for culverts and subdrains. Where the totals of types used are greater than the number of counties reporting, some counties use more than one material.

State	Number of Counties Reporting	Types of Culvert Materials		Types of Subdrain Materials		
		Corr. Iron	Concrete	Corr. Iron	Concrete	Tile
Alabama	4	2	3	2	1	—
Arizona	3	3	1	—	1	—
Arkansas	7	3	4	1	1	1
California	24	21	9	11	4	3
Colorado	6	5	2	2	1	—
Florida	7	5	5	1	1	1
Georgia	9	9	3	4	1	2
Illinois	43	39	26	7	5	26
Indiana	29	28	14	8	5	10
Iowa	59	49	52	7	12	31
Kansas	77	52	45	16	2	2
Kentucky	13	9	7	2	2	2
Michigan	32	30	15	6	5	29
Minnesota	65	60	46	18	10	18
Mississippi	5	3	3	1	1	1
Missouri	15	12	4	1	—	1
Montana	14	13	2	6	1	1
Nebraska	22	19	9	3	1	3
Nevada	1	1	—	—	—	—
New Jersey	8	6	4	1	—	5
New Mexico	1	1	1	—	—	—
New York	21	11	16	10	1	12
North Dakota	10	9	9	1	1	1
Ohio	41	33	38	7	7	30
Oklahoma	19	10	12	—	—	1
Oregon	19	16	14	5	9	4
Pennsylvania	7	5	5	—	—	6
South Carolina	4	1	3	—	2	—
South Dakota	19	14	14	2	4	3
Tennessee	10	10	7	2	—	3
Texas	12	9	7	3	2	1
Utah	5	4	2	—	1	2
Virginia	5	4	2	—	1	2
Washington	21	16	18	5	13	4
West Virginia	7	6	4	4	—	—
Wisconsin	23	21	8	8	1	3
Wyoming	7	7	1	1	—	3

Building A Three-Million-Gallon Concrete Reservoir At Billings, Montana

Details of the design and construction of a tank with pre-stressed reinforcement and roofed with a self-supporting slab dome.

By A. L. HEWETT,
Superintendent, City Water Department, Billings, Mont.

A. L. Hewett, Superintendent.

WHEN the City of Billings, Mont., found it necessary in 1940 to provide additional storage reservoir capacity of three million gallons, Black & Veatch, consulting engineers, were selected to design it and bids were received on June 11, 1940, on plans and specifications for two types of reservoir—one a rectangular reservoir designed under the conventional system, the other a circular tank using the Hewett system of pre-stressing the steel bands. The lowest bid was $64,110 by the Northwestern Engineering Company of Rapid City, South Dakota, on the circular tank. This bid was $5,220 lower than the lowest bid received on the rectangular tank, and was accepted.

The tank as constructed is 160 feet inside diameter and 20 feet deep, with a capacity of three million gallons. The depth of 20 feet was fixed by the overflow elevation of an adjoining reservoir. The roof of the circular tank is a self supporting slab dome, and is the largest dome of this character in this country and probably the largest in the world.

The principal feature used in the design of circular tanks under the Hewett system is pre-stressing of the bands which resist stresses due to internal pressure. This system of construction has been in use for about twenty years and many large tanks and domes have been built in all parts of the country, including two in Billings, and several others elsewhere in Montana.

The wall of the tank was built double. An inner wall 11 inches thick was built first and around it were placed the reinforcing bands. After these bands had been stressed to the proper tension, a second wall of concrete 4½ inches thick was placed outside the inner wall. The second wall gives additional bearing for the bands, bonds them to the wall and protects them from corrosion. The double wall rests on a circular footing.

Dome of roof of 3,000,000-gallon reservoir.

In the order of construction the footing was placed first. Since the rim of the floor slab rests upon the footing and no bond is desired between footing and floor, the top of this footing was floated to an even surface, which was lightly troweled and then carefully coated with emulsified asphalt to prevent a bond between the footing and the superstructure. The floor slab was next placed. As the floor slab is not attached to the footing, it is free to shrink without stress.

The inner form for the sidewall was next constructed, and all the steel to be incorporated in this 11-inch wall was placed. This steel consisted of 810 ⅝-inch vertical rods, 405 of which were spaced 2 inches from the inner face, and 405 1½ inches from the outer face of the 11-inch wall. These vertical rods were held in position by ten ½-inch circular rods. To prevent weak horizontal joints, the 11-inch wall was constructed in four vertical sections, each section being placed in one working day. The vertical joints were provided with recesses on the inner face which were later filled with waterproof mortar. This wall was also provided with recesses on its outer face, 1¼ inches deep and 14½ inches wide, to provide space for the turnbuckles used in tightening the bands.

Below the dome band (described below) there are 46 bands, each band made up of 13 rods, 1⅜ inches by 38 feet 10 inches long, with right and left hand cold-rolled threads to fit 1½-inch standard turnbuckles. The rods were so assembled on the tank that the levers used in tightening the turnbuckles moved downward and the amount of stress in the band is measured by the weight of the workman and the length of the lever, special levers of proper length being provided. After the bands had been adjusted, five hundred ⅜-inch vertical rods were wired to the band rods to give additional anchorage to the 4½-inch cover wall, which then was placed. Where the sidewall joins the floor slab, four bands are placed around the floor, which insure a tight joint at that point.

Since there may be a material difference between tank and roof in respect to loads and temperature, it was necessary to separate the domed roof entirely from

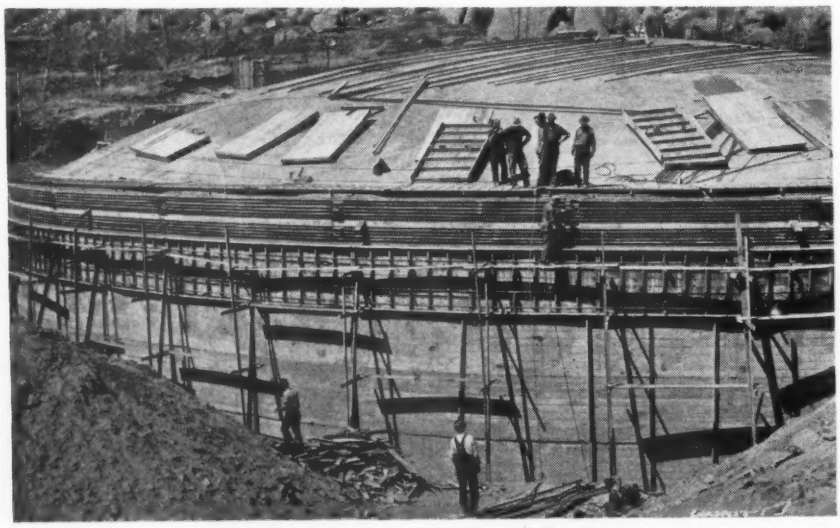
the tank wall. The top of the wall was therefore floated with a wood float to an even surface, lightly troweled and thoroughly coated with emulsified asphalt to allow independent movement of the dome.

The dome roof is attached to a surrounding ring, which takes the thrust. This ring consists of an inner ring 11 inches thick by 3 feet 8 inches deep, with the dome slab attached to its center. On this 11-inch ring were placed ten bands, each of thirteen rods, 1⅜ inches by 38 feet 10 inches These bands were covered by a wall 6 inches thick, and a second line of ten bands, each of thirteen rods 1⅜-inch by 39 feet 10 inches, was placed and covered with a cover wall 4½ inches thick. The 11-inch wall of this band ring was reinforced with 481 ½-inch stirrups and 8 ½-inch circular rods. The dome ring is tied to the dome slab by 408 dowels, ½-inch by 5 feet 8 inches. Drainage through the dome ring is provided by 15 cast iron scuppers. The construction joint between the dome slab and the dome ring is located 12 inches inside of the dome ring so as to be out of the gutter.

The dome slab is a segment of a sphere 5 inches thick except that it is thickened to 7 inches at the edge by a tangent to the outer surface. The inside radius is 170 feet and the rise of the dome is 20 feet or one-eighth of span. The dome is provided with a ventilator at the center, 4 feet inside diameter, the openings of which are covered with 14-mesh bronze screens.

The dome construction not only insures against cracking, since all parts are in compression, but since it is self supporting, the floor is free of concentrated loads due to roof-supporting columns, which often cause trouble.

On account of severe weather, the work of construction was stopped Nov. 1, 1940, and was not renewed until the following April. The wall was therefore unprotected for a period of about five months, after being placed and before the bands were adjusted. The shrinkage opened up vertical cracks which were visible in nearly all of the thirteen recesses, and when the tank was first filled the surface dropped at the rate of about 15 inches in five days, indicating considerable leakage. The tank was emptied and examined and leaks in the vertical shrinkage cracks were indicated. The cracks were repaired by channeling and filling with metallic waterproofing. After final repair to these cracks, the tank was filled and the surface drop was only one inch in five days, including evaporation.



3,000,000-gallon reservoir under construction.

Lumber for Bridge Work in Sedgwick County, Kansas

Many county highway departments are finding stocks of pressure treated dimension lumber particularly practicable, since a stock comprising easily obtainable sizes of plank will provide material suitable for a wide variety of bridge and culvert construction. Items for which common sizes of dimension lumber are suitable include laminated end walls for bulkheads, transverse laminated decks on conventional stringer or joist systems, and longitudinal laminated decks or slabs with sufficient strength for the ordinary panel length without stringers.

The engineering department of Sedgwick County, Kansas, has used laminated or strip floors for building many new bridges and redecking old steel spans. The common practice of placing a transverse laminated floor of 2 x 4 or 2 x 6-in. plank on edge over treated timber joists or stringers has been followed in a number of instances. In many newer structures, however, a continuous longitudinal laminated deck has been used in which the strips, arranged in a regular staggered pattern, provide a slab of sufficient strength for the ordinary bent spacing without the use of joists.

Pieces are laid on edge and spiked together to form a solid laminated floor, usually with two rows of spikes on 2-ft. centers, one along either edge, and staggered. Generally, 60d spikes are required for 3-in. and 50d for 2-in. material. Lumber for both the transverse and the longitudinal type is usually surfaced, since a smooth, level surface is desirable, either on an unprotected floor or on one carpeted only with a light bituminous mat.

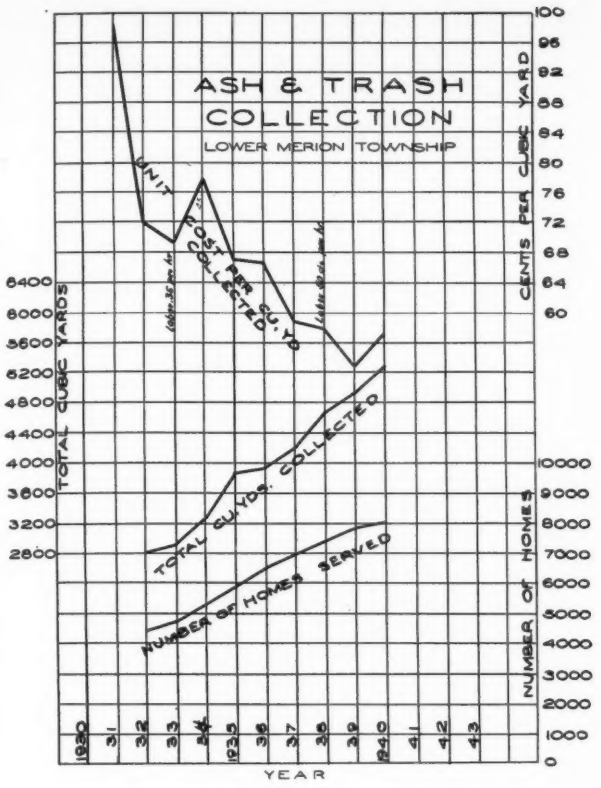
In the case of the transverse laminated floors, this county generally employs 2 x 4-in. plank for decking the old steel bridges and either 2 x 4-in. or 2 x 6-in. plank on the new structures, depending upon the spacing of the stringers. Where rolled steel beams are used for stringers, the spacing in most cases necessitates the 6-in. floor thickness.

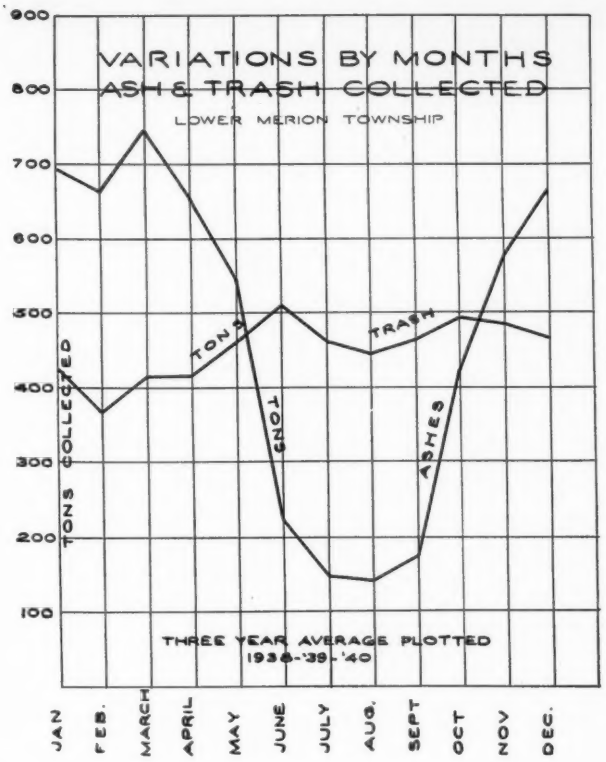
The longitudinal continuous decks made of 8-in. plank on edge have been used by the county for spans of 16 to 20 ft., both on new trestles and as decking for old steel bridges with similar panel lengths.

Laminated abutment and wing walls were built with random lengths of 2 x 4-in. lumber. A tight joint at the juncture of the wings and the abutment is obtained by overlapping alternate strips and spiking them together. This type of back wall has proven very satisfactory, particularly because of its strength, rigidity, and freedom from cracks which might permit the escape of approach fill material.

All lumber used in Sedgwick County is southern yellow pine or Douglas fir pressure treated with creosote by an empty-cell process with a final retention of 10 lbs. of creosote per cubic foot of wood, in accordance with standard specifications of the American Wood-Preservers' Association.

Until recently, O. C. Carlson was county engineer of Sedgwick County. George Heinig is now county engineer, with headquarters at Wichita.—*Condensed from "Wood Preserving News."*





Collection and Disposal of Ashes and Trash By Lower Merion Township

By W. E. ROSENGARTEN
Township Engineer, Ardmore, Pa.

Methods and costs of collection and disposal on dumps and by incineration. Collection by township forces preferred to that by contract.

EACH service rendered by a municipality adds to the tax load, and none should be undertaken unless it is a public necessity for the health or welfare of the community. The collection and disposal of ashes and trash seems to meet this requirement, for they inevitably collect and if not removed regularly they become a nuisance and a health and fire menace; and our studies have shown that public collection gives the service at a fraction of the cost of private collection.

In February, 1921, Lower Merion Township, Pennsylvania, tried municipal collection of refuse. The service was weekly in winter and monthly in summer, making a total of thirty-five collections yearly. The material was picked up from the cellars and a direct charge was made to each one availing themselves of this service of from $5 to $36 per year, depending on the size of the house. This charge was slightly less than 60% of the cost. Only 350 houses, or one-third of the total in the built-up sections of Ardmore utilized the collection, and service was discontinued after three years. The average collected per house was 10,441 pounds of ashes and 913 pounds of trash. The cost was $4.12 per ton, or $21.27 per house per year.

An increasing demand for public collections led the Board of Commissioners again to institute a collection of household wastes in September, 1931, the entire cost being paid from regular township funds. At first collection was confined to the more thickly populated sections, comprising 45% of the area and at least 80% of the population. Later the area served was extended to include the entire township of 25 square miles and 40,000 people. When the collection was started, only 4,600 homes utilized the service, a number retaining the private collectors, who removed the wastes from the cellar while the present township collection is from the rear line of the house. The number of patrons has steadily increased until, at present, ashes and trash are being removed from over 8,000 homes, or 80% of the total. We may anticipate continued increases in the number, since in 1940, a total of 406 new homes were built in the township.

Regulations.—Regulations governing the collections have been set up, printed and distributed to all homes by the Board of Commissioners. They require that the waste materials be placed in containers near the rear line of the house but visible from the street, not in the highway right-of-way except in the few sections where solid row houses exist. (This eliminates the untidy appearance in a residential community where containers are in evidence along the roadside for a day or more.)

Trash-collecting truck.

Household waste materials are to be separated into (1) ashes and (2) trash or other wastes, including shrubbery, trimmings, boxes, papers, cans, metal, crockery, bottles, etc. Garbage is not permitted in either of these classifications as it is collected separately. The ashes must be in metal containers with handles, of approximately one bushel capacity. All other materials must be in closed containers of not over four bushels or be bundled together and securely tied.

Not more than 100 pounds of waste material will be collected at one time from any one household. (This is intended to insure that waste material be put out regularly for collection and not allowed to accumulate. An accumulation of wastes is a fire hazard and unsanitary. Also, large amounts put out occasionally unduly delay the schedule of the collection forces.) Waste materials from commercial establishments, such as stores, manufacturing plants, and hotels, are not collected by the township.

If for any reason the regulations, such as location or type of containers, are not complied with, a special "red tag" is attached to the containers on which has been checked the infraction of the rules.

Collections are made once every two weeks between the hours of 7 A. M. and 4:30 P. M. When a collection day falls on Memorial, Fourth of July, Labor, Thanksgiving, Christmas or New Year's day, the collection is made on the following working day.

Organization.—The Township is divided into 8 districts, one of which is served each collection day. In general these coincide with the election districts or some physical boundary, but they are balanced in size so that each requires about the same time to service. Collections are made on Tuesday, Wednesday, Thursday and Friday; and recently at the suggestion of the fire marshal a special weekly collection has been made each Saturday from the homes in the business districts of Bryn Mawr, Ardmore and Bala as a safety measure. Three trucks are used throughout the year on trash and three additional trucks are used on ashes in the winter months. More recently, in several of the districts which have grown the fastest, it is necessary to hire an additional truck and men in order to cover the area in one working day and permit the entire Township to be covered in two weeks.

In general, each district is divided into three routes, each of which is covered by a truck manned by a driver and three laborers. Both 2½ and 1½-ton trucks are used. The cost of operation has averaged nine cents and six cents per mile respectively. They haul four cubic yards of ashes and ten cubic yards of trash. Drivers are paid $.55 per hour for ten hours a day and laborer $.50 per hour for a nine hour day. The men are supplied with uniforms, a gray coat and trousers; also rain coats marked with "L.M. Twp." and a number. Collections proceed in all kinds of weather except in very heavy storms; which are usually of short duration. This organization is under the direction of a foreman on the street. The Superintendent of Maintenance supervises the collection and disposal of waste materials as one of his duties.

In addition to the routine collection of ashes and trash, the organization picks up piles of dirt or leaves gathered by the motor sweepers. On Mondays they handle road maintenance in a section of the Township assigned to them. In emergencies they are called on to clean up storm debris or to spread cinders when roads are icy. All trucks are equipped with snow plows. They were called into service, night and day, to plow and haul away the Friday snows of February 28th and March 7th, 1941.

Quantities and Costs.—Each truck driver keeps a card account of his mileage, gas and oil and the number of loads hauled. A careful record of collection data and costs has been compiled. The accompanying tables give a summary of this information. It is to be noted that the volume collected has increased from 28,044 cubic yards in 1932 to 52,963 in 1940, nearly doubling in nine years. The average collected yearly from each home served is 2 cubic yards of ashes and 4½ cubic yards of trash. On the basis of 1,000 pounds per cubic yard for ashes and 230 pounds per cubic yard for trash this is about one ton of ash and one-half ton of trash. The cost of the collection is $.57 per cubic yard or $2.37 per ton. It is but $.15 for each house visit, or $3.80 per house per year. The per capita cost for the removal of ashes and trash for the year was $.76.

Ash and Trash Collection—1940

Month	*Ash C.Y.*	*Trash C.Y.*	*Total C.Y.*	*Cost*
January	1,991	3,129	5,120	$2,958.45
February	2,056	2,472	4,528	2,905.62
March	2,072	2,862	4,934	2,917.99
April	1,808	3,042	4,850	2,525.10
May	1,432	3,146	4,578	2,549.63
June	856	3,289	4,145	2,117.85
July	716	2,905	3,621	2,033.72
August	640	2,714	3,354	2,028.49
September	872	2,621	3,493	1,823.91
October	1,412	3,529	4,941	2,660.92
November	1,548	3,169	4,717	2,935.62
December	1,733	2,949	4,682	2,747.60
Total C. Y.	17,136	35,827	52,963	$30,204.90
Total Tons*	8,568	4,136	12,704	

*Tonnage computed on basis of ash 1,000 pounds per cubic yard and trash 230 pounds per cubic yard obtained from weighings at the incinerator.

Ash and Trash Collection—1931 to 1940

Year	*Total Cost*	*Cubic Yards*	*Cost per Cubic Yard*
1931 (4 mos.)	$ 2,025.30	6,992	$ .99
1932	20,248.59	28,044	.72
1933	20,264.91	29,192	.69
1934	25,982.72	32,653	.79
1935	26,213.42	38,938	.67
1936	26,554.22	39,831	.67
1937	24,984.05	42,005	.59
1938	27,260.52	46,599	.58
1939	26,442.45	49,410	.53
1940	30,204.90	52,963	.57

Disposal of Wastes.—Trash is hauled to the incinerator in the southeastern part of the Township, an average distance of three miles. Ashes are collected separatly and a considerable portion is dumped at locations scattered throughout the Township where fill is desired. The average haul of this material is but two miles.

Township Dump.—Prior to the public collection of waste materials in Lower Merion Township, the Board of Commissioners wisely foresaw the need for a public dump and in 1918 purchased a tract in the southeastern

part of the Township, containing 17.733 acres. It contained a deep ravine which provided an ideal place for dumping wastes. In 1936 this was enlarged to 30.6 acres by the purchase of an adjoining property. For years this location has served as a dump for the most of the waste materials of the Township. The privilege of dumping was extended to private trucks for twenty-five cents per load. Permission also has been obtained for using, as a dumping place for ash, a quarry hole in the central and another in the upper part of the Township.

The practice which was developed as the most satisfactory for disposal of trash was to spread it over the top of the dump and once or twice a week, when the materials were dry and the wind was in the right direction so that the smoke would not annoy nearby residents, the area was burned over. The residue was then pushed over the face of the dump. When material was not burned on the surface but dumped directly over the face, trouble was experienced from internal burning of the fill with its resulting disagreeable odors.

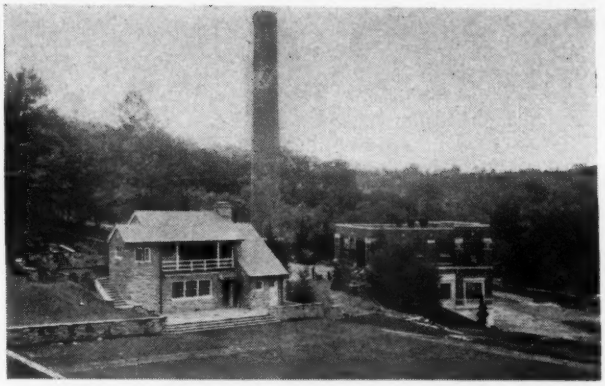
Incinerator.—In order to eliminate complaints concerning the dump, the Board of Commissioners investigated the possibilities of incineration. When it was decided to erect a plant on the Township dump a storm of protest arose from the surrounding community, that it would make the property a permanent dumping ground and concentrate truck traffic in the vicinity. It was pointed out that the property had been used as a dump prior to the purchase of properties of many who complained, and that space was available for many years dumping in the future. The question was decided in the Courts in favor of the Township.

In 1938-39, with the assistance of Federal P.W.A. funds, an incinerator housed in a carefully designed brick structure was erected on a hillside on the township dump property at a cost of $105,000. The building was of sufficient size to house a furnace with a capacity of 150 tons in 24 hours. Since garbage was hauled away from the Township and fed to hogs, only one-half the furnace units were installed. The furnace is a Pittsburgh-Des Moines type with superheater and ornamental stack of 125 feet height, designed by Albright & Friel, consulting engineers, and erected by H. R. Dickens, contractor. During the past two years the area has been landscaped and parked so that it will soon be a real asset to the community. There is also being constructed on the property, one of the finest police pistol ranges in the country.

Operation of Plant.—The incinerator was put into service in June, 1939, and has been operated successfully since that time. The force consists of a Superintendent and four stokers, whose time is staggered so that three are on duty during the middle and latter part of the day; and one is on the job until 10:00 P. M. to clear out the firebox and put the building in readiness for the next day's operation.

The Township has granted to an individual the privilege of salvaging any material of value from the trash as it arrives at the incinerator, in return for which he agrees to load all trash into the furnaces. He has six to eight men at work sorting through the material on the loading floor. Paper, rags, bottles and metals are the principal materials salvaged, 23.5% of the trash received being salvaged and the remainder burned.

Charging floor of incinerator.



At right, 150-ton incinerator. Police pistol range in foreground.

All material received at the plant is weighed, as is also the salvage and residue. During the past year 5,987 tons were received, from which 1,401 tons were salvaged and a residue of 2,098 tons, principally cans, were removed from the furnaces and placed on the dump. We are now developing a screen to separate the cans from other ash residue with the idea of selling the cans. While this may not be especially lucrative, it will gratly reduce the volume placed on the dump and produce a better grade of fill. There is space on the property for filling for a number of years, but if the rate of filling can be reduced, it will extend the period further into the future, when dumping areas will be even more limited than at present.

The total cost of operation in 1940, the first full year the plant was in service, was $11,004.77 or $1.84 per ton of trash received at the plant. The average cost during the first six months operation was $1.94 per ton. The per capita cost of refuse disposal is $.27. This, with the collection costs, makes a total of $1.03 per capita.

Arrangements have been made to receive waste materials from the Borough of Narberth, a community of 1,500 homes, and 5,000 people, covering one square mile and entirely surrounded by this Township. In 1940 they brought to the incinerator 776 tons, or 13% of the total received. The Borough pays for this service on the prorata cost of $1.90 per ton. In addition, they pay $50 per year for the privilege of dumping ashes. Private loads from the Township are received at the incinerator at a charge of $.25 per load. The rate is low to encourage private collection and frequent hauling of waste materials from the stores; too high a rate would tend to encourage dumping of trash along roadsides or the accumulation of wastes on the properties, creating an unsanitary condition and a fire hazard. In 1940 there was collected $831.50 for the dumping privileges of 3,326 private loads.

Township Forces vs. Contract.—The question is frequently raised as to the relative desirability of collection of wastes by either township forces or by contract. Much can be said on both sides but the real answer depends on how the many factors involved are handled. Township forces, if properly organized and supervised and not demoralized by political influence, are definitely able to give better service than can be obtained with a contractor. They are more flexible and

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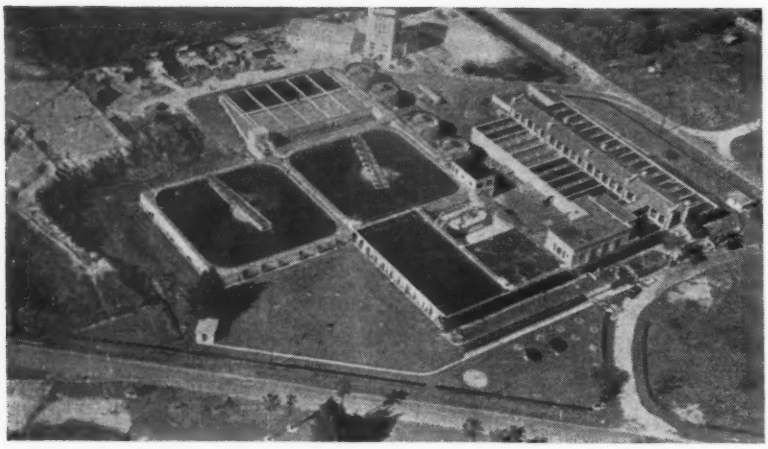


Salt Wa ru

By A. B. DE WOLF

Mechanical Engineer, Dept. of Water Supply and Sewers, Miami, Fla.

Aerial view of Miami production and treatment plant.

THERE is an adequate supply of fresh water to satisfy the needs of Miami, Fla., in the area adjacent to the city, but the increase in number of wells by which it is obtained has lagged behind the growth in population and from time to time the wells have been taxed beyond capacity and become salty. This has not been caused by the drawing of salt water directly from the ocean, as in some other cities. To understand the cause and effect of salt intrusion at Miami it is necessary to discuss some of the geography and topography of southern Florida.

Miami is located at the mouth of the Miami river, on Biscayne bay. Extending north from here, paralleling the east coast, is a low ridge 10 to 20 ft. above sea level and 10 to 15 miles wide, west of which lie the Everglades. These are a low muck prairie, almost perfectly flat, covered with saw grass and sloping south from Lake Okeechobee at about 2″ per mile. During a portion of every year and nearly all of some years it is covered with fresh water from a few inches to 2 or 3 ft. deep.

The depth of the muck which constitutes the soil of the Everglades varies from 10 ft. at Lake Okeechobee to a few inches at its other borders and is underlaid by sand and shell in some places, by marl in others. These are fairly permeable and provide excellent storage for fresh water, although there are occasional areas where the water in them is too highly mineralized to be potable.

Most of the water on the surface of the Everglades is dissipated by evaporation and transpiration, but a small part is drawn off by several drainage canals extending to the sea. One of the principal of these is the Miami canal, extending southeast from Lake Okeechobee to the Miami river. From the mouth of the river to a point 30 miles northwest of Miami there is an average depth of water of 9 ft. but for the remaining 42 miles muck only was removed.

Miami's water production plant is located near this canal about 7 miles from the mouth of the river. Water is obtained from 15 shallow wells driven into the permeable formation lying close to the surface, not far from the edge of the Everglades; the organic matter in the soil of these probably accounting for the organic color of the water. The surface soil in this area consists for the most part of a thin layer of soft limestone rock with scattered sandy areas, underlaid by sand beds and these in turn by rock which is highly permeable and yields copious supplies of fresh water. Beneath this, generally 100 ft. or more below the surface, is an impervious stratum. Normally the water table stands in the lower part of the upper stratum of rock, to which it slopes slightly from the Everglades, giving a slow movement of water from them to the wells. In addition to this, the water in the canals contributes to the well field, as surface water to some point near the wells and as ground water the rest of the way. The Miami canal, being the one nearest to our wells, is the one that most affects our supply. For 4.2 miles from the river mouth the channel is 15 ft. deep, for 1.3 miles the depth is 12 ft. and for 26 miles more, in which section our wells are located, the depth is 8 ft. About 14 miles above the plant is an earth dam maintained by the drainage authorities, above which the canal is only a shallow depression in the muck.

During high water in the Everglades there is a constant flow of water down the channel to the sea, which diminishes as the water table lowers and finally becomes so slight that salt water from the ocean contaminates that in the canal and ultimately movement in the canal is confined to ebb and flow of the tide, salt water extending up stream a distance varying inversely with the ground water level.

In 1938-39 occurred the driest spell in years, there being practically no rain from early fall to late spring, and salt water extended to and beyond the water plant. As the plant had operated for 15 years without any trouble, little attention was paid to the situation; and it was a decided shock to find a significant increase in the chloride content of some of the wells and that it had risen to 440 ppm in the canal opposite the plant and for three miles up stream from it, and finally reached 15,400 ppm opposite the plant. The water table in the well field was considerably below mean sea level and lower than the canal level at low tide, and more or less canal water reached the wells nearest the canal until these had to be shut down, the salinity reaching 114 to 1900 ppm of chlorine. Fortunately one group of wells was so far from the canal that the encroachment was not felt immediately and, by using these only, the water delivered to the city was not materially affected.

In May, 1939, heavy rains fell and conditions in the canal returned to normal but the well field did not re-

Temporary dam at N W 36th Street.

Va rusion At Miami

Due to salt water backing seven miles up Miami river to site of the city's wells when unusually dry spells greatly diminish the flow of the river. Remedies tried and proposed.

cover immediately. It was thought that recovery might be hastened by pumping the wells and discharging the water into the canal, and this was done for several weeks and probably had a beneficial effect, but the return to normalcy was slow. Meanwhile, the chloride content of the group of wells farthest from the canal began to increase, reaching a maximum of 450 ppm; these increases not being noted until from about 45 days to several months after the wells nearest the canal were affected.

The serious implications were immediately realized, and an extensive survey of water supply conditions was provided for by a contract made with the U. S. Geological Survey by the cities of Miami, Miami Beach, Coral Gables and Dade County. A four-year program was mapped out, the estimated cost of which was approximately $300,000, half to be borne by the Federal government and half by local interests. A

Entrance of production and treatment plant.

small force of government employes began the study in October, 1939, the force being later enlarged until a well-organized group of experts is now busy gathering and studying information. A first progress report indicates that there is ample water available in the area for several cities the size of Miami, provided it is properly safeguarded.

Meantime the engineers of Miami's Public Service Dept. endeavored to devise a plan for preventing a recurrence of the trouble in the immediate future. They believed that if the canal at the plant and for a mile or more down stream could be kept at a level slightly above high tide there would be no danger of salt penetration; and that this could be accomplished by controlling the outward flow as soon as the water table upstream from the plant became low enough to permit use of the ground for agricultural purposes; the control station being such as to present no resistance to flow during flood conditions. However, agricultural interests protested against the plan and the Drainage

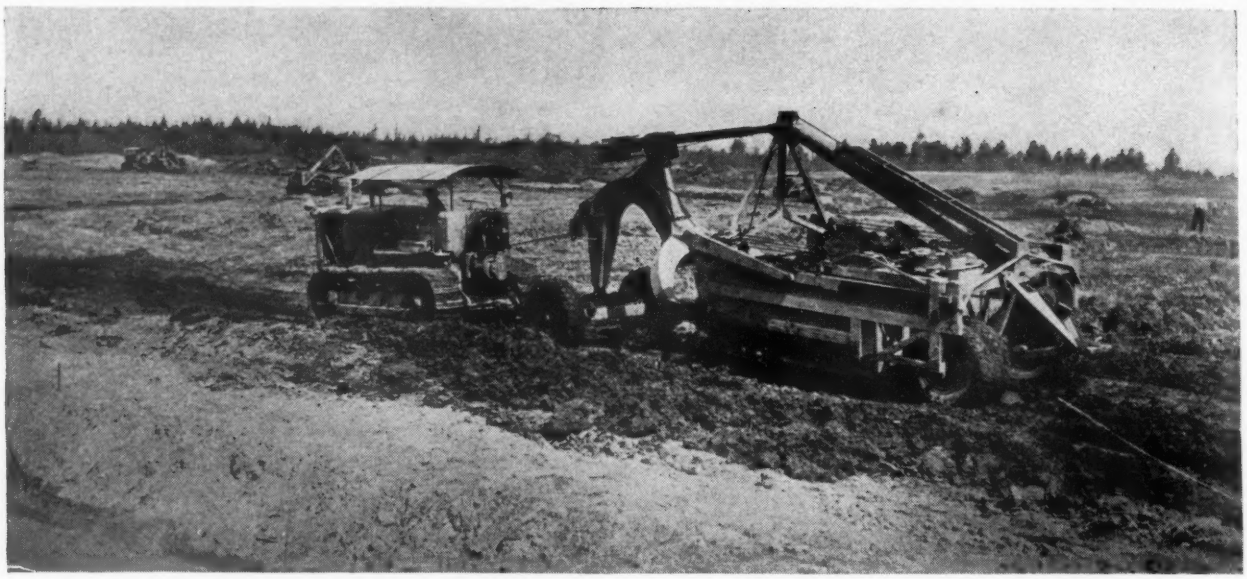
Miami canal, looking toward Lake Okeechobee from end of rock excavation. Note choking by vegetation.

Board refused to permit construction of the control works.

In the spring of 1940 salt water again moved up the canal and when it approached dangerously near the plant the city took emergency measures. A temporary steel sheet piling dam was constructed in the canal two miles below the plant. The dry spell continued for something over a month, during which period the wells and the canal at the plant remained fresh; but just before the end the fresh water table had fallen below high tide level and salinity began to appear in the water above the dam. A breach was made in the earth dam 14 miles above the plant (previously mentioned), above which the water stood 2 ft. higher than below, and flow through this forced the salt water back to the down-stream side of our temporary dam. A few days later the situation was saved by heavy rains—so heavy that they caused considerable damage to the crops upstream from the water plant. This damage was attributed by the owners to our temporary dam and claims were filed against the city, none of which have yet been settled.

Immediately after the breaching of the earth dam, five 36″ steel culvert pipe were set in the breach, with a gate valve in each, which valves were closed when the rain came. Also when the rain began to raise the canal, gates in the temporary dam were opened, and 48 hrs. later the entire dam was removed. A few days later the canal 8 miles above the plant was higher than before the dam was removed; which, with a number of other factors, seems to demonstrate that the flooding was not due to the temporary dam.

This year there has been sufficient rainfall to prevent recurrence of the trouble; but as the city's water demands increase it will be more and more imperative to work out a system of protection against salt water intrusion. Such a system is now being drafted, guided by information being furnished by the U. S. Geological Survey.



Clearing the airport. Carryalls and other heavy equipment were mired in mud caused by heavy rains.

Constructing The Whatcom County, Washington, Airport

Deep peat deposits and long, heavy rains made grading of the clay soil difficult. More than sixty pieces of equipment used.

THE 373-acre Whatcom County airport is located approximately four miles northwest of the City of Bellingham, Washington, on the west side of the U. S. Highway No. 99, on a terrain 150 ft. above sea level and slightly higher in elevation than the surrounding country and found to be comparatively free from fog. The prevailing wind is from the southwest, which was the determining factor in locating the runways.

Work on this airport was started in 1936 under a WPA project to provide a Northeast-Southwest landing field 500 ft. wide and 2,300 ft. long. No drainage or surface work was done on this project, and no work was done on the airport during 1937 and 1938 due to lack of sponsor's funds, but in March, 1940, the project was re-opened. The initial operation consisted of draining surface water from many small ponds. Also a main drainage system was designed and work begun for draining the sites of the runways before beginning any excavation work.

Excavation was begun in April, 1940, to complete 3,400 ft. of graveled runway for immediate use. During the course of construction it was found that the plans furnished by the sponsor did not provide for balancing quantities of cut and fill, either for extensions of the existing runway or for the addition of future landing areas, and a complete engineering survey was started to determine the changes necessary for constructing a complete three-runway, Class 4 airport.

Soil soundings showed that the many ponds on the field were filled for a considerable depth with a peat formation which was unstable and would have to be removed completely from areas in runways. The surrounding ground was of clay formation, impervious to moisture, and the drainage system was designed to carry off surface water only, with the exception of french drains at the edges of the runways. The survey showed that very little fall was to be had and that drainage must be carried in three separate directions. The peat extended as much as 20 ft. below drainage, thus creating a problem in excavation. Soundings to 35 ft. indicated no water table. The drainage system was designed for one inch per hour of rainfall and has proven adequate under severe weather conditions.

The final step in design was the determination of shrinkage factor and balancing of earthwork quantities. Tests indicated a shrinkage of from 10 to 15 per cent and a factor of 15 per cent was decided upon. Grades were established and quantities balanced for a maximum haul of one thousand feet. The actual balance was within two per cent. Excavating operations were planned as follows: hauls over 700 ft. to be moved by shovels and trucks, those under 700 ft. by carryalls, and hauls under 200 ft. with bulldozers. Peat excavation was planned to be handled by draglines loading onto trucks for spreading and disposal.

In August, 1940, the Army approved the project as a National Defense unit. The project was approved for construction of two runways and actual grading operations started September 10. Early in 1941 the Civil Aeronautics Authority furnished non-labor funds for the construction of another runway (the North-South runway), and the paving of runways North-South and Northwest-Southeast.

The daily yardage moved during the month of September, 1940, averaged 14,000 cu. yd. The plan of operation described above was adhered to until heavy rains during the month of October made a complete change necessary, and the haul on carryall work was lengthened and shovel operations were cut down due to the difficulty and high cost of maintaining truck roads. During the month of September-October approximately 400,000 cu. yd. of excavation was hauled at an average cost of 16c per cubic yard.

Peat excavation operations progressed without difficulty until rainfall made disposal of peat by trucking impossible because of the scattered locations of peat deposits. Because of the shallow drainage outlets from the airport area it was necessary to remove water from the peat excavations by pumping before back-filling with impervious material. On the north end of the Northwest-Southeast runway a peat deposit approximately 12 acres in area extended partially into the runway. As wet weather prevented disposal by trucks, the peat under the section of the runway that was to be paved was removed completely by other methods, but, in view of the seven to eight feet of fill over the balance of the peat, a dike was cut across the deposit along the edge of the runway fill to completely enclose the unremoved peat with a compacted fill dike. The peat left under the unpaved part of the runway varied in depth from two to eighteen feet and this was covered with compacted fill. As the fill increased in depth, the weight forced the water to the surface and it was removed by pumping. As the water was removed from the peat and the embankment increased in depth, it was noticed that the quaking action gradually ceased and the fill finally became stable. This operation, which made it possible to avoid the removal of approximately 25,000 cubic yards of peat, was accomplished by the use of a 1½-yd. drag line with a 60-foot boom working from the face of the embankment. Backfilling was done with two 12-yd. carryalls and the material placed and compacted with a bulldozer. The peat excavated was piled outside of the runway area.

Grading operations continued throughout the winter months. At times the material removed had a moisture content too great to permit adequate compaction and many parts of the project had to be postponed until dry weather. Tracks, or ruts, made by the earth-moving equipment were a continual source of trouble during the rainy months and the services of large forces of WPA workers were required to maintain drainage of surface depressions.

Gaveling and oiling of the Northeast-Southwest runway for a distance of 3,600 ft. was completed on October 8, 1940. French drain installation was initiated thereafter and the work progressed with the extension of the runway grading operations. Continual rainfall throughout the winter precluded excavation operations on the Northeast-Southwest and Northwest-Southeast runways and necessitated confining the operations to the building site until more favorable weather.

Grading operations were started on the North-South runway during the month of April, 1941, and all excavation was completed by the end of July, 1941, after an exceptionally wet and rainy spring.

The drainage system consisted of a concrete gutter 5 ft. wide on each side of runway pavements, under which was placed a 6-inch tile line in a french drain 2.5 ft. deep, the lower one-third of the tile joints being sealed with cement mortar and the remaining two-thirds of the joint left open to receive water entering through the gravel of the drain. Catch basins were installed every 500 ft., with drop inlets at mid points between, to take water from the gutters. The drop inlet boxes were "cast-in-place concrete"; the catch basins were built of sectional concrete rings 3 ft. 6 inches in diameter. Lateral runoffs from the catch basins removed the water to open ditches at the edge of the landing strips. The minimum grade of the drains was held to 1.2 per cent, with an average of 1.4 per cent.

Gutters for shoulder protection were provided on all fill sections. These consisted of half-sections of 12", concrete tongue-and-groove pipe, with drop-out spillways every 300 ft. Culverts under the landing strips varied in diameter from 18 to 36 inches.

Paving operations, both asphaltic concrete and portland cement base course, were started on June 12, 1941. A stock pile of pit-run gravel containing 45,000 cu. yd. was made on the airport. This was hauled from a pit located five miles from the project, at a cost of 32c per cu. yd. in the stock pile. The Northeast-Southwest runway was paved with a 2½" mat of asphaltic concrete (hot-mix) using pit-run aggregate screened to one-inch; to which was added about 2 per cent by weight of fines (60 to 80 screen) obtained from a pit located on the project, and 5.1 per cent by weight of 120-150 penetration asphalt. The normal day's production was about 500 tons of asphaltic concrete, and the 90,000 sq. yds. could have been laid in thirty days, but wet weather held up completion until August 22, 1941.

The Northwest-Southeast and the North-South runways were paved with 6" of a very dry mixture (slump absolutely zero) of ¾ bbl. of portland cement to one cubic yard of pit-run gravel aggregate. This was spread with an asphalt paving machine, then rolled with a ten-ton roller. Shrinkage due to rolling amounted to approximately 30 per cent. The surface was given paper cure for 72 hours, then kept wet for four days with sprinkler tank trucks. The result was a dense grade of concrete of very high compressive strength; however, surface waves could not be controlled to very close limits and the result was a slightly waved surface, presumably due to slight variations in aggregate gradings.

All through the operations, rain created sub-grade difficulties that retarded operations considerably, and in the final 6,000 sq. yd. one barrel of portland cement was used per cubic yard of concrete. Operations were completed about November 5, 1941. Test cylinders made of this concrete were broken and showed compressive strength of 2,800 pounds per square inch at ten days and 3,300 pounds at twenty-one days. Some 25,000 square yards of standard concrete (1¼ bbl. cement per cu. yd.) was poured in five turning aprons located at the ends of the runways

The concrete mixing plant consisted of a 2-yard Smith titling mixer, a 2-yard volumetric batching hopper, and a 16-yard steel bunker. The plant was a gravity layout, the bin being charged by a ¾-yd. shovel loading from two 3-yard trucks; a small bulldozer aided in the work.

Lighting installations, consisting of runway contact lights, boundary and range lights, ceiling projector and wind direction and velocity indicators, have been

(Continued on page 36)

Due to the war we are unable to publish some very good air views of this project which were originally furnished to us by the WPA.

Rows of powdered Colprovia asphalt left by lime spreader, being mixed into oil-coated aggregate by bladers. U. S. Route 224.

Specifications tur

D. Prime Coat

General.—In many types of bituminous surfaces, a prime coat is a requisite. This section is meant to provide specifications for priming which are applicable for use with, and may be made a part of, the specifications for any type in which a prime coat is a part of the procedure.

1. *Description.*—This work shall consist of an application of bituminous material on the previously prepared base, roadbed or existing surface, in the amount stated in these specifications, shown on the plans or directed by the Engineer, and in conformity with the lines and sections shown on the plans or indicated by the Engineer. (Note: The amounts of butuminous material and of aggregate required depend upon the type of surface to be treated.)

2. *Bituminous Materials.*—The type and grade of bituminous materials designated in the plans and in the proposal shall be used. All bituminous materials must meet all of the requirements for the specified type, as stipulated in Section A, par. 2.

3. *Construction Methods.*—a. Equipment shall comply with the provisions of Section B, par. 1. The Contractor shall furnish all equipment required for proper performance of the work.

b. Cleaning the Surface.—The existing roadbed or base course shall be thoroughly cleaned by brooming, supplemented by such other equipment as may be necessary. Equipment for cleaning shall consist of one or more mechanical sweepers of an approved type having steel fiber brooms, and hand scrapers, shovels and brooms. All mud, earth, dust and other foreign materials shall be removed. Where earth or mud on the surface retains moisture, it shall be removed sufficiently in advance of the final cleaning to insure that the surface will be thoroughly dry. On waterbound macadam, sweeping shall be continued until the embedded stones are uncovered and cleaned, but not dislodged, and spaces between the stone particles are exposed to a depth of approximately ½ inch. Special care shall be taken to clean the edges of the road. Material removed during the cleaning process shall be swept to the sides, or to a windrow, or removed and disposed of as directed by the engineer.

c. Application of bituminous material will not be permitted when, in the judgment of the Engineer, the surface to be treated is not dry to the depth of expected penetration; or when the atmospheric temperature is below 50° F.

d. The surfaces of all structures shall be protected by a satisfactory method or device to prevent them from being marred by bitumen.

e. The specified type and grade of bituminous material shall be applied with an approved pressure distributor at the rate designated by the engineer. (This will generally be at the rate of 0.30 to 0.40 gal. per sq. yd. in one application), and at the temperature specified (generally 80° to 130° F). Application must be uniform, and at no point shall it exceed the amount specified. If any areas are missed, these shall be treated by such means as will insure uniform application.

f. When so directed by the engineer, the priming coat shall be applied to one-half the width of the roadway at a time, and traffic shall be confined to that section of the road not being treated. Work shall not be started on the second half until the area covered by the first application has dried and is ready for traffic. The Contractor, at his own expense, shall furnish lights, flagmen and barricades and shall properly control traffic.

4. *Measurement of Work.*—The quantity to be paid for shall be the actual number of gallons of bituminous material applied. (There are various methods of measurement. On small city and county jobs, it is usually sufficient to require the Contractor to exhibit freight and material bills, especially when a check is maintained of the material on the basis of tank car and bituminous distributor capacity.)

5. *Payment.*—Payment shall be made at the contract price per gallon, this price to include furnishing, heating, delivering, hauling and storing; cleaning the surface, applying the materials; and labor, freight, demurrage, tools, equipment and incidentals. Deductions will be made for material used as fuel, wasted or improperly used.

Maintenance of Primed Surface.—The application of the prime coat is a preliminary to the construction of most bituminous treatments. Generally the same contractor will do both phases of the work. In such cases, the following should be inserted under Par. 3, above: The Contractor shall, at his own expense, maintain the prime coat treatment and the surface of the base course until it has been covered. He shall clean out any spots where the prime coat may have failed, due to pot holes, disintegration of underlying material or other cause; and exposed areas resulting shall be lightly scarified, dampened, refilled with selected material, and thoroughly tamped so as to conform with the surrounding

tuminous Surfaces for Highways and Airports

The second of three installments, of which the first was published in the February issue. In this issue, surface treatments and road mix surfaces, open aggregate type.

areas; after which bituminous prime shall be applied by a hand hose equipped with a nozzle or with a hand pouring pot. However, if in the opinion of the Engineer satisfactory repairs cannot be accomplished in this manner, the Contractor at his own expense shall reapply prime material after thorough sweeping and repair.

E. Surface Treatments

General.—There are many types of surface treatment, selection between them depending mainly on local conditions. Single, double and triple applications are sometimes made. The specifications given herein can be utilized for nearly all conditions that may arise.

1. *Preparation of Surface.*—Information and some details have been given in Section C.

2. *Application of Priming Coat.* — Specifications have been given in Section D.

3. *Description of Work.*—The work shall consist of one or more applications of bituminous material on the previously prepared base or surface, with a covering of gravel or other aggregate, following by brooming and rolling. (Note: In some places, the coat is dragged also; but since dragging is generally restricted to heavier applications than are contemplated here, it will be considered separately.)

4. *Materials.*—a. Bituminous.—Bituminous materials shall meet the specifications listed under Section A, Par. 2, and shall be of the variety and grade shown on the plans (or specified herewith).

b. Aggregates.—Aggregates shall meet the specifications listed under Section A, Par. 1, and shall be of the sizes shown in Table 1, "Aggregate gradings for surface treatment" when asphaltic bituminous material is used; and of the sizes shown in Table 2 when tar is used. (Note: Where it is desired to use other sizes, or to provide for satisfactory local materials, proper substitutions can be made in this paragraph.)

5. *Cleaning the Surface.*—If the primed base, under traffic, has become dusty or muddy, it should be recleaned as specified in Sect. D, Par. 3b.

6. *Protection of Structures* should be provided as in Sec. D, Par. 3d.

7. *Construction Methods.*—a. No bituminous material shall be applied until the primed base has been properly cured and is firm, intact and thoroughly dry. The bituminous material shall be heated and applied at the temperatures specified, (these depend upon the material used), and at the rate directed by the Engineer. Application must be by an approved pressure distributor. Special attention shall be given to preventing appreciable overlapping of adjacent applications. Bituminous material shall be applied only on such portions of the surface as will be covered with aggregate during the same working day that the oil is applied. (Ordinarily aggregate is applied within a few minutes.) All traffic and all equipment must be kept off the bituminous material until it has been adequately covered with well-embedded aggregate. Bituminous materials will not be applied when the atmospheric temperature is below 50° F.

b. As soon as the hot bituminous material has been applied, the aggregate for the cover coat shall be uniformly distributed over the surface at the rate specified (this is determined by local factors, but will usually be about 10 lbs. per square yard of aggregate for each 0.10 gallon of bitumen). Spreading of the aggregate shall be by means of an approved mechanical spreading device. (See paragraph below for hand-spreading alternate.) Coarse aggregate spread when the temperature of the air is above 70° F may contain normal moisture; but air drying, satisfactory to the engineer, will be required when the atmospheric temperature is below 70° F. Trucks or spreaders shall not drive on the uncovered bituminous material.

c. Hand Spreading of Aggregates.—When aggregates for surface treatment are spread by hand, as provided in the specifications or permitted by the Engineer, they shall be scattered or thrown in a direction parallel to the center line of the road; and when not distributed uniformly shall be dragged or broom-dragged as directed by the engineer.

d. Broom-Dragging.—Immediately after the coarse aggregate has been spread, the surface shall be rolled once lightly to set the aggregate and then dragged with a light drag broom or rotary broom, supplemented by hand brooming until a smooth and even surface is obtained. Additional aggregate shall be spread as required. (Some specifications provide for brooming before rolling.)

e. Drag-Mixing.—In some areas, when the aggregate cover is over 40 pounds per sq. yd., the use of a mixing drag is required, as follows: After spreading of the aggregate, and before rolling, the aggregate shall be dragged with an approved mixing drag until it has been thoroughly coated.

f. Rolling.—Rollers.—The following is a satisfactory specification for rollers: The power rollers shall be

rollers rated at 3 to 6 tons capacity; and may be of the tandem or 3-wheel type (tandem rollers are preferable). Rubber tired disc type rollers of approved design may be used. Other types of rollers may be permitted which exert a pressure of from 125 lbs. to 225 lbs. per lineal inch of compression rollers.

Immediately after brooming (or dragging), the covered surface shall be rolled in a longitudinal direction. The rolling shall begin at the outer edges of the treatment and progress toward the center, each trip overlapping the previous trip by at least one-half the width of the roll. The rolling shall be repeated as often as, in the opinion of the Engineer, is necessary to insure thorough keying of the coarse aggregate into the bituminous material. The rolling shall follow close behind the spreading of the aggregate and the initial rolling shall be done within one hour after the aggregate is placed. If deemed advisable, the initial rolling may be done before the dragging operation. Slow moving light highway traffic may be allowed to use the road as soon as the coarse aggregate has been spread. When this is done, the Contractor may be required to control speed by convoy. Sweeping of the excess aggregate back over the surface may be required.

When, in the judgment of the Engineer, the coarse aggregate has become sufficiently embedded in the bitumen, the Contractor shall remove all excess cover material from the surface.

g. Maintenance and Protection. — The Contractor will do at his own expense all the customary maintenance work on the base course, shoulders, slopes, ditches, and the surface treatment on the road within the limits of this Contract, from the time he starts work on any part of the Contract until all work in the Contract has been completed and during the maintenance period. This work shall include immediate repairs of any defects that may occur either before or after seal coat is applied, which work shall be repeated as often as may be necessary to keep the road continuously intact. Repairs are to be made in a manner that will restore a uniform surface and insure durability of the part repaired.

The contractor shall provide the necessary warning and limited speed control signs, together with the necessary watchmen that may be deemed advisable by the Engineer, in order to control and regulate traffic during construction and until acceptance.

h. Part-width construction may be required as provided under Section D, Par. 3 f.

i. Measurement of Work.—While it is possible to pay for the work done on the square yard basis, payment on the basis of materials used is preferable, as follows: (1) Bituminous materials shall be measured as specified in Section D, Par. 4.

(2) Mineral aggregate for armor coat shall be measured by the cubic yard, in the vehicles at the points of loading, at which points the Contractor will be required to strike off the material to uniform heights even with the tops of the boxes of the vehicles.

j. Basis of Payment.—(1) Bituminous Material Applied.—Bituminous materials which are applied as surface treatments, measured as herein provided, shall be paid for at the contract price per gallon. This price shall be full compensation for furnishing, heating, delivering, hauling, and storing all bituminous material; for applying bituminous material to the road; and for all labor, demurrage, equipment, tools, and incidentals thereto. Deductions for all bituminous materials used as fuel, wasted, or not used as directed by the Engineer, will be made.

(2) Mineral Aggregate.—Aggregate will be paid for at the contract price per cu. yd., which price shall be full compensation for furnishing, measuring, hauling, distributing and rolling the cover coat material, and maintaining the cover coat, and for all materials, equipment, labor, demurrage, tools and incidentals thereto.

F. Road Mix Surfaces

There are two principal types of road mix surfaces: the *open-graded* or macadam aggregate and the dense graded. The choice between them usually depends upon such local factors as availability of material. Where all aggregate must be hauled in, the open-graded surface is normally used, but where all or part of the existing aggregate in the road can be utilized, the dense graded type may be more economical.

I. Open Aggregate Type

The following specification is slightly condensed from a preliminary specification of the U. S. Public Roads Administration:

1. *Description.*—This item shall consist of a wearing course composed of open-graded aggregate mixed in place on the road with bituminous material; and of key or choker aggregate, and a seal coat, the whole constructed on the prepared roadbed in accordance with these specifications and in conformity with the lines, grades, and typical cross section shown on the plans.

TABLE 8.--Quantities per square yard for three different wearing surfaces

Aggregate gradings and sequence of operations	120		150		200		
	A	B	A	B	A	B	C
Coarse aggregate for mixing:							
Grading A (lbs.)					175		
Grading B (lbs.)	105		125			175	
Grading C (lbs.)		120		150			200
Bituminous material for mixing:							
Using cut-back asphalt or tar:							
First application (gal.)	0.30	0.40	0.35	0.45	0.40	0.40	0.55
Second application (gal.)	0.25	0.40	0.30	0.45	0.40	0.40	0.55
Using emulsified asphalt:							
First application (gal.)	0.30	0.45	0.35	0.50	0.40	0.40	0.60
Second application (gal.)	0.25	0.45	0.30	0.50	0.40	0.40	0.60
Key aggregate:							
Grading D (lbs.)					25		
Grading E (lbs.)	15		25			25	
Bituminous material for penetration:							
Using cut-back asphalt or tar (gal.)	0.25		0.25		0.30	0.30	
Using emulsified asphalt (gal.)	0.35		0.35		0.40	0.40	
Total quantities exclusive of seal coat:							
Aggregate (lbs.)	120	120	150	150	200	200	200
Bituminous material:							
Using cut-back asphalt or tar (gal.)	0.80	0.80	0.90	0.90	1.10	1.10	1.10
Using emulsified asphalt (gal.)	0.90	0.90	1.00	1.00	1.20	1.20	1.20
Seal coat:							
Choker, Grading F (lbs.)		5		5			5
Bituminous material (gal.)		0.10		0.10			0.10
Choker, Grading F (lbs.)		7		7			7
Cover, Grading G (lbs.)	15		15		15	15	
Bituminous material (gal.)	0.30	0.25	0.30	0.25	0.30	0.30	0.25
Cover, Grading G (lbs.)	12	15	12	15	12	12	15
Total seal coat quantities:							
Aggregate (lbs.)	27	27	27	27	27	27	27
Bituminous material (gal.)	0.30	0.35	0.30	0.35	0.30	0.30	0.35

2. *Quantities of Material per Square Yard.*—Table 8 covers three different wearing surfaces differentiated by poundage figures — 120, 150, and 200 — in the respective designations. For each of the three wearing surfaces, one or more sets of gradings for the aggregate are specified in the table. The poundage figures —120, 150, and 200—indicate the total poundage of aggregate prescribed per square yard of each respective wearing surface, exclusive of the seal coat.

The table specifies the approximate amounts per square yard of each successive application of bituminous material and spreading of aggregate. The sequence of operations for each respective wearing surface shall be as set in Table 8.

The weights given in Table 8 are those of aggregates having a bulk specific gravity of 2.65, as determined by A.A.S.H.O. Method T-85. Proportionate

corrections shall be made when the aggregates furnished on the job (job aggregate) have bulk specific gravities above 2.75 or below 2.55. In such case the corrected amount shall be the product of the number of pounds shown in Table 8 multiplied by the ratio of the bulk specific gravity of the job aggregate to 2.65.

The amounts given in Table 8 are approximate and the exact amounts shall be set by the engineer for each application and spreading. Total amounts of bituminous material per square yard may be varied by the engineer as necessary to fit conditions, but the total amount of aggregate per square yard, after adjustment for specific gravity, shall not be changed, except that the engineer may order a portion of it to be placed in stockpiles, and similarly, he may order some of the apportionment for stockpiling used on the road.

3. *Materials.* — *a. Aggregate.* — Aggregate shall be crushed gravel, crushed stone, or crushed slag and shall meet the requirements for grading given in Table 9, using A.A.S.H.O. Methods T-11 and T-27. It shall also meet the requirements of Section A, Par. 1.

TABLE 9.--Requirements for grading of aggregates

Sieve designation	Percentage by weight passing square mesh sieves (A.A.S.H.O. T-27)						
	Coarse			Key		Choker	Cover
	Grading A	Grading B	Grading C	Grading D	Grading E	Grading F	Grading G
2-1/2-inch	100						
2-inch	90-100						
1-1/2-inch	35- 70	100					
1-inch	0- 15	90-100	100				
3/4-inch			90-100	100			
1/2-inch		0- 15		90-100	100		
3/8-inch			20- 55	40- 75	90-100		100
No. 4			0- 10	0- 15	10- 30	100	75-100
No. 8			0- 5	0- 5	0- 8	85-100	0- 10
No. 200	0- 2	0- 2	0- 2	0- 2	0- 2		0- 2

Choker aggregate shall consist of a crushed product and shall be produced during the crushing and screening of the aggregate for road-mix and seal coat.

b. Bituminous Materials.—(1) One of the following materials, whichever is called for in the bid schedule, shall be furnished.

Rapid-curing cut-back asphalt meeting the requirements of Table 10.

Emulsified asphalt, mixing grade, conforming to A.A.S.H.O. Specification M-48.

Emulsified asphalt, penetration grade, conforming to A.A.S.H.O. Specification M-51.

Tar conforming to A.A.S.H.O. Specification M-52.

TABLE 10.--Requirements for grading of aggregates

Sieve designation	Percentage by weight passing square mesh sieves (A.A.S.H.O. T-27)				
	Grading A	Grading B	Grading C	Grading D	Grading E
1-inch	100	100	100	100	100
3/4-inch	75-100	75-100	85-100	85-100	85-100
No. 4	30- 45	40- 60	45- 65	50- 70	60- 95
No. 10	20- 35	25- 45	30- 50	35- 55	45- 80
No. 200	2- 7	3- 8	5- 10	5- 12	5- 15

(2) Grades (with temperatures of application in degrees F.) shall be as follows:

Cut-back asphalts—RC-3 (175-225), RC-4 (200-250); Emulsified asphalt (60-120); Tar—RT-5 and RT-6 (80-150), RT-7, RT-8, and RT-9 (150-225).

The grade of cut-back asphalt or tar shall be as called for in the bid schedule, provided, however, that when the grade is not so fixed one of the above grades shall be selected by the engineer.

When emulsified asphalt is called for in the bid schedule, mixing grade shall be used for mixing applications and penetration grade shall be used for the penetration and seal applications.

4. *Construction Methods.—a. Weather and Seasonal Limitations.*—Surface courses shall be constructed only between May 1 and October 1, and operations shall be carried on only when the surface is dry, when the atmospheric temperature is above 60° F., and when the weather is not foggy or rainy. The temperature and seasonal requirements may be waived by the engineer.

b. Equipment.—The equipment used by the contractor shall include mixing, spreading, finishing, brooming, and compacting equipment, a self-powered bituminous material distributor, and equipment for heating bituminous material.

Aggregate spreading equipment shall be adjustable so that it will spread uniformly the required amounts per square yard. Blade graders for mixing, laying, and finishing shall be of the self-powered type, and shall have blades not less than 10 feet long and wheelbases of not less than 15 feet. Such graders shall be of not less than 3 tons in weight and shall be equipped with pneumatic tires. Rollers for compacting the surface shall be of the self-powered tandem or 3-wheel type weighing not less than 8 tons each.

Either traveling or stationary mixing plants or other equipment of proved performance may be used by the contractor if advance written approval is given by the engineer, and if the contractor complies with such requirements as the engineer may consider necessary to insure results which would be obtained by use of the specified equipment.

c. Spreading Road-Mix Aggregate.—Immediately before placing the aggregate, the existing surface shall be cleaned of loose or deleterious material by sweeping with a power broom, supplemented by hand brooming if necessary. Road-mix aggregate of the grading and in the amount called for shall be spread uniformly on the prepared surface. Aggregate shall not be spread within 18 inches of the proposed pavement edges. Immediately before the first application of bituminous material, the engineer shall test the road-mix aggregate for moisture. If the moisture content is more than 2 percent of the dry weight of aggregate, the contractor shall turn the material with blade graders or otherwise aerate it until the moisture content is 2 percent or less. The aggregate shall then be respread as provided above.

d. First Application of Bituminous Material.—When the aggregate has been spread as required above, the bituminous material shall be applied to it uniformly with the prescribed pressure distributor and in the amount per square yard determined by the engineer.

Bituminous material shall be so applied that uniform distribution is obtained at all points. Unless the distributor is so equipped as to obtain this result at the junctions of applications, building paper shall be spread on the surface for a sufficient distance back from the end of each application so that flow through sprays may be started and stopped on the paper and so that all sprays will operate properly on the entire length being treated. Building paper so used shall be immediately removed and burned. Application temperatures of bituminous material shall be as provided in the specifications for the particular bituminous material being used. During all applications of bituminous material the surfaces of adjacent structures and trees shall be protected to prevent their being spat-

tered or marred. Bituminous material shall not be discharged into borrow pits or gutters.

e. Partial Mix.—Immediately following the application of bituminous material, it and the aggregate shall be mixed by blading from side to side of the road, or by manipulations producing equivalent results, until all particles are coated with the bituminous material and the whole mass has a uniform color. During the mixing, care shall be taken to avoid disturbing the underlying base or contaminating the mixture with earth or other extraneous matter. When so directed the mixing process shall be confined to part of the width or area of the road so as to allow a convenient passage for traffic. After the mixing, the bituminized mixture shall be again spread in place to receive the second application of bituminous material.

f. Second Application and Mixing.—Immediately after the first mixing and before the bituminous material is entirely dried or set, the second application shall be made in the required amount per square yard as determined by the engineer and shall be thoroughly road-mixed as required for the first application. The mixing shall continue until all particles are thoroughly and uniformly coated with bituminous material. The mxture shall then be spread and bladed to the specified width and cross section.

g. Initial Rolling and Planing.—As soon as the mixture has been shaped the whole surface shall be rolled, each trip of the roller slightly overlapping its previous path. The roller wheels shall be kept oiled or moistened to prevent picking up the mixture. Any area that tends to ravel shall be repaired with premixed material. After one rolling, any irregularities in the surface shall be corrected by planing with the blade grader or other approved equipment and rerolling if so directed by the engineer.

h. Spreading Key Aggregate and Third Application.—After the surface has been allowed to cure properly, key aggregate, if called for, shall be spread uniformly in the required amount per square yard as determined by the engineer. The surface shall be broomed or broomdragged, or both, until the surface voids are filled. Only the amount of key aggregate necessary to fill the surface voids shall be used. The surface shall not be "blinded" and the mixed aggregate shall remain partly visible through the key aggregate. As soon as the key aggregate is in place, the third or penetration application of bituminous material shall be made in the amount determined by the engineer.

i. Placing Choker Aggregate and Application of Seal.—After initial rolling and planing have been completed and before the mixture has set, choker aggregate, if called for, shall be spread uniformly at a rate of approximately 5 pounds per square yard. The surface shall be hand broomed or drag broomed, or both, until surface voids are uniformly filled. Bituminous material shall then be applied at a rate of approximately 0.1 gallon per square yard and additional choker aggregate spread uniformly at a rate of approximately 7 pounds per square yard, after which the surface shall be alternately broomed and rolled until the road-mixed aggregate and the choker aggregate are thoroughly bonded. Any excess choker aggregate shall then be removed and the surface again rolled until hard and compact. Exact rates of application of bituminous material and choker screenings shall be as ordered by the engineer. The moisture content of choker aggregate shall not be more than 3 percent of the dry weight of aggregate.

j. Rolling of Keyed or Choker Surface.—Rolling of the keyed or choked surface shall be longitudinal and shall commence at the outer edges of the road, overlapping the shoulders, and progress to the center of the road, overlapping each preceding passage by an amount not less than one-third the width of the roller, except that on superelevated curves rolling may progress from the lower to the upper edge. Under no circumstances shall the center of the road be rolled first. Rolling shall be continued until the surface is thoroughly compacted. If ordered by the engineer rolling of the keyed surface shall be continued at proper intervals for several days.

k. Shaping Edges.—While the surface is being compacted and finished, the contractor shall trim the edges neatly to line.

l. Application of Final Seal Coat.—Where key aggregate is used, the keyed surface shall be sealed not less than 24 hours after completion of the rolling. Where choker aggregate is used, the choked surface shall be open to traffic for at least 2 weeks before the seal coat is applied. Immediately before placing the seal coat, the choked surface shall be cleaned of loose or deleterious material by sweeping with a power broom, supplemented by hand brooming if necessary.

In the case of seal coat for the keyed surface, a spreading of cover aggregate shall be made first, followed by an application of bituminous material and a second spreading of cover aggregate. The seal coat for the choked surface shall consist of an application of bituminous material followed by a single spreading of cover aggregate. In either case, the bituminous material applied shall be covered immediately with cover aggregate. The exact quantities of materials for seal coat shall be determined by the engineer.

Bituminous material shall be applied as provided in sub-paragraph d above. Initial spreading of the cover aggregate shall be done with the aggregate spreading equipment specified. Trucks spreading aggregate shall be operated backward so that bituminous material will be covered before truck wheels pass over it. Supplemental spreading and smoothing shall be done with a broom drag, and by hand methods where necessary. The surface shall be alternately broom-dragged and rolled until the cover aggregate is uniformly and thoroughly bonded over the full width.

m. Stockpiling.—Cover aggregate shall be stockpiled at the rate of 15 tons per mile at locations and in piles of such forms and amounts as the engineer may direct. Stockpile sites shall be cleared, cleaned, and leveled by the contractor.

5. *Method of Measurement.*—*a.* The yardage or tonnage of aggregate to be paid for shall be the number of cubic yards or tons of primary course aggregate, choker aggregate, and cover aggregate actually used in the accepted work or placed in authorized stockpiles. When key aggregate is required, the yardage or tonnage of primary course aggregate shall be the combined yardages or tonnages of coarse aggregate and key aggregate. When payment is by the cubic yard, measurement shall be made in the vehicles at the point of delivery.

b. The unit of measurement for bituminous material shall be the gallon or the ton, whichever is called for in the bid schedule. The gallonage or tonnage to be paid for shall be the number of gallons or tons of bituminous material used as ordered in the accepted work. Gallonage shall be determined by measuring the material at a temperature of 60° F., or by converting the gallonage measured at other temperatures to gallonage

CLASS H—FINE AGGREGATE OF SAND OR SCREENINGS

	Bottom Course	Top Course	Single Course
Bit. Sol. in C.S.₂	3 to 8%	5.5 to 7%	4 to 6%
Passing No. 80	0 to 5%	0 to 12%	0 to 5%
Passing ⅜ inch—Retained No. 80	8 to 20%	15 to 40%	10 to 30%
Passing ½ inch—Retained ⅜ inch	0 to 15%	20 to 45%	10 to 30%
Passing ⅝ inch—Retained ½ inch	20 to 45%	25 to 45%	25 to 45%
Passing 1 inch—Retained ⅝ inch	45 to 70%	0 to 5%	15 to 35%
Passing 1¼ inch—Retained 1 inch	0 to 10%		0 to 5%

CLASSES I AND J—FINE AGGREGATE OF SAND

	Class J		Class I		Binder
	Sheet	Topeka	Fine Type	Coarse Type	For I or J
Bit. Sol. in C.S.₂	9.5 to 12%	7 to 10%	7 to 9.5%	6 to 8%	4 to 6%
Passing No. 200	10 to 20%	4 to 10%	4 to 10%	4 to 8%	
Passing No. 80—Retained No. 200	10 to 32%	5 to 25%	4 to 20%	4 to 15%	
Passing No. 40—Retained No. 80	25 to 55%	12 to 40%	8 to 35%	4 to 30%	15 to 30%
Passing No. 20—Retained No. 40					
Passing No. 10—Retained No. 20					
Passing No. 10—Retained No. 40	10 to 40%	7 to 30%	5 to 25%	4 to 20%	
Passing ¼ inch—Retained No. 10	0 to 10%	15 to 45%	10 to 30%	5 to 15%	
Passing ½ inch—Retained ¼ inch		0 to 15%	15 to 35%	15 to 35%	20 to 45%
Passing 1 inch—Retained ½ inch			0 to 15%	15 to 40%	25 to 50%
Passing 1¼ inch—Retained 1 inch				0 to 10%	0 to 10%
Total Passing No. 40 Not Less Than					
Total Retained No. 10	0 to 10%	20 to 45%	30 to 55%	45 to 60%	64 to 81%

CLASSES I AND J—FINE AGGREGATE OF SCREENINGS

	Class J		Class I	
	Sheet	Topeka	Fine Type	Coarse Type
Bit. Sol. in C.S.₂	9 to 12%	7 to 10%	6.5 to 9%	6 to 8%
Passing No. 200	8 to 22%	5 to 17%	4 to 14%	3 to 11%
Passing No. 80—Retained No. 200	4 to 18%	3 to 14%	3 to 13%	2 to 10%
Passing No. 40—Retained No. 80	6 to 30%	4 to 24%	3 to 18%	2 to 16%
Passing No. 20—Retained No. 40	10 to 30%	5 to 24%	4 to 21%	4 to 17%
Passing No. 10—Retained No. 20	10 to 35%	5 to 28%	4 to 26%	4 to 22%
Passing No. 10—Retained No. 40				
Passing ¼ inch—Retained No. 10	0 to 15%	15 to 45%	10 to 30%	5 to 15%
Passing ½ inch—Retained ¼ inch		0 to 15%	15 to 35%	15 to 35%
Passing 1 inch—Retained ½ inch			0 to 15%	15 to 40%
Passing 1¼ inch—Retained 1 inch				0 to 10%
Total Passing No. 40 Not Less Than	23%	14%	12%	9%
Total Retained No. 10	0 to 15%	20 to 45%	30 to 55%	45 to 60%

Specification Designation	Paving Grade Asphalt Cement	Colprovia Hard Asphalt	Colprovia Asphaltic Flux Oil	Bituminous Binder
General Requirements	The material must be homogeneous and free from water and shall meet the following requirements when tested as indicated			
Specific gravity, 77° F	1.00 - 1.04	-	Not less than 0.97	Not less than 1.00
Penetration, 77° F, 100 gr., 5 sec.	40 - 100	Not more than 3	-	60 - 150
Penetration, 115° F, 100 gr., 5 sec.	-	Not more than 10	-	-
Loss on heat, 5 hrs., 50 gr., 325° F	Not more than 1%	-	Not more than 5%	Not more than 3%
Penetration of residue, 77° F, 100 gr., 5 sec. % of original	Not less than 60%	-	-	Not less than 60%
Bitumen soluble in carbon bisulphide	Not less than 99.5%	Not less than 99%	-	Not less than 99.5%
Ductility, 77° F	Not less than 60	-	-	Not less than 60
Flash Point, open cup	Not less than 347° F	-	-	Not less than 347° F
Melting Point, R & B	-	225° F to 280° F	-	-
Furol Viscosity, 122° F	-	-	600 - 800	-

at 60° F. in accordance with A.S.T.M. Designation D 206-36.

6. *Basis of Payment.*—The quantities of materials, determined as provided in Par. 5*a* and *b* above, shall be paid for at the contract unit price per cubic yard or per ton as the case may be, which prices and payment shall constitute full compensation for furnishing, handling, mixing, manipulating, and placing all materials, for all shaping and compacting including rolling, for finishing, for reconditioning subgrade, shoulders and gutters, for cleaning up pits and quarries, for clearing, cleaning, and leveling stockpile sites, for furnishing and sealing of scales, for furnishing the weigh house, for facilitating and controlling traffic, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Colprovia Mixtures

As stated previously, we are including specifications for several prepared or proprietary paving mixtures. One of these is given below.

Colprovia paving processes cover several methods of introducing various special bituminous materials into mixtures of any desired aggregate gradation to produce cold-laid mixtures. Where conditions make it desirable, the processes are adaptable to hot mixing and hot laying as well. Specifications covering Colprovia heated process mixtures of the usual classes are given below. The table of composition of mixtures under Section 4C is given as known to be satisfactory. However, Colprovia bituminous materials may be used with any desired aggregate gradation for either open or dense mixtures.

Specifications for Colprovia Heated Process Mixtures

1. Description.—Colprovia Heated Process requires that, in addition to cold aggregate, flux, and powdered asphalt, a portion of the aggregate shall be heated and coated with sufficient standard paving grade asphalt cement to produce an improved initial stability in a paving mixture which may still be handled cold without the necessity of using temporary ingredients to thin or otherwise act upon the asphalt.

The asphaltic courses herein described shall consist of mineral aggregate thoroughly coated with bituminous materials as set forth below, as shall be necessary to make a mixture conforming to the compositions given in the proposal. The paving course shall be constructed upon a prepared base in conformity with the lines, grades, and typical cross-sections indicated on the plans, unless otherwise directed, and in accordance with the provisions of these specifications.

2. Materials.—Coarse aggregate shall be crushed stone, crushed slag or gravel meeting the requirements of Sec. A, Par. 1.

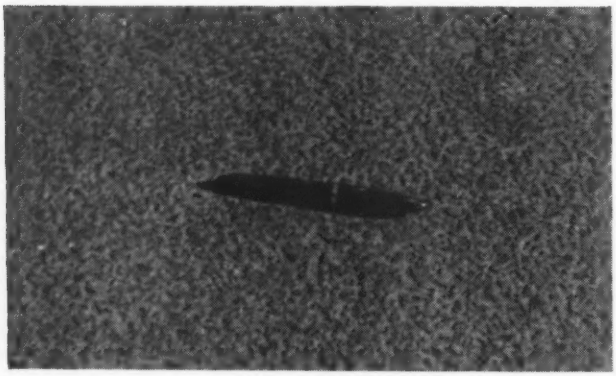
Fine aggregate shall consist of sand, stone screenings, or slag screenings, or a mixture of any two. The sand shall consist of clean, hard durable grains, free from clay, loam, and other foreign matter. The stone screenings shall be free from weathered particles and the larger particles shall be free from adhering dust. The rock from which they are crushed shall be similar in character to that specified under "Stone." Slag screenings shall be free from dirt or other foreign material and shall be at least equal in quality to "Slag" specified under "Coarse Aggregate." Sufficient sand may be added to the screenings or screen-

ings added to the sand as necessary to improve their gradings. Any material retained on the No. 10 sieve shall be considered as a portion of the coarse aggregate, and that passing No. 200 sieve, if approved, may be considered as filler. (See tables, page 32.)

Filler shall be thoroughly dry limestone dust, or other approved material, the whole of which shall pass a No. 30 sieve, and at least seventy per cent of which shall pass a No. 200 sieve. Hydrated Lime may be used as part of the filler in a quantity not to exceed 1% of the total mixture if necessary to improve the character of any paving mixture This lime shall comply with the latest requirements of the A.S.T.M.

3. Bituminous Materials.—The bituminous binder shall be composed of three component parts, of which one shall be an asphalt paving cement not fluid at air temperature, a second shall be a grade of asphalt hard enough to be reduced to powder in an impact mill, and the third an asphaltic flux capable of amalgamating cold with the hard asphalt. Specifications are given in Table C. (See page 32.)

4. Preparation.—(a) Mineral Aggregates. The coarse and fine aggregates shall be proportioned separately for each batch of the paving mixture. In the mixtures other than Sheet all of the coarse aggregates shall be introduced into the mixer in a dry and heated condition. The fine aggregate need not be heated but shall be dried before mixing. In the Sheet mixtures not less than 25% of the total aggregate shall be introduced in a dry and heated condition. The remainder need not be heated but shall be dried before mixing. The temperatures of the aggregates shall be so regulated that the finished mixtures will be produced within a temperature range between 90° F. and 200° F.



Texture of H-type Colprovia, heated process.

(b) Bituminous Materials. The hot asphalt cement shall be introduced into the mixer at a temperature between 225° F. and 350° F. The flux shall be introduced at a temperature not to exceed 150° F. The hard asphalt shall be reduced to powder in an impact mill. As used, not less than 50% of it shall pass a No. 80 sieve, and 95% shall pass a No. 20 sieve, and shall be delivered to the mixer in this state.

(c) Composition of Mixtures. The composition of Colprovia paving mixtures shall conform to the limits set out in the individual columns of the table given herewith. The proportions within the limits given shall be designated by the Engineer.

5. The Mixture.—The various components of the mixture shall be separately and accurately measured by weight for each batch to be mixed. The mixture shall be made in an approved twin pug mill or other type of mixer satisfactory to and approved by the Engineer, by first charging with the required amount of heated aggregate and adding thereto the weighed quantity of hot asphalt cement and mixing until all of the heated aggregate is uniformly coated. After this, the remainder of the aggregate, together with the required amount of flux, shall be added and mixing continued until every particle of the aggregate is thoroughly coated. At this stage, the required amount of powdered asphalt shall be added either alone or in combination with some or all of the filler, and mixing continued until the powdered asphalt is evenly distributed throughout the mix.

6. Preparation of Base.—The base should be prepared as directed in Section C. The paving mixture will be laid only upon a base that is dry and when in the opinion of the engineer, weather conditions are suitable.

7. Laying.—The mixture shall be spread by means of shovels, rakes, or approved spreading devices, in a loose layer of such depth that after compaction it shall produce a uniform course having the depth shown on the plans. Care shall be taken in refueling and greasing and cleaning mechanical spreaders that no solvent material contaminates the mixtures. Side supports such as curbs, gutters, or edgings, timbers or other supports of suitable thickness shall be laid along each side of the pavement and rigidly supported so as to prevent the mixture from being displaced by the action of the roller. These temporary supports shall remain in place until the top course has been thoroughly rolled. After the temporary side supports are removed, the edges of the pavement shall be thoroughly rolled with overlapping rolls so as to consolidate the extreme edges.

8. Rolling.—The surface shall be consolidated thoroughly and uniformly by a power driven roller. After initial rolling it may be opened to full road traffic. Either initial rolling or final rolling may be done with a roller weighing not less than 5 tons, but the compression of an 8 ton or heavier roller should be obtained at some period. The motion of the roller shall be slow enough at all times to avoid displacement of the mixture.

9. Joints.—Constructing the top course shall be as nearly continuous as is possible. The roller shall pass over the end of the laid mixture only when absolutely necessary. When the operation of laying is interrupted, the end of the laid material shall be left unrolled until such time as work is resumed, in order that there may be no joints throughout the project. When laying in parallel lanes at least six inches of loose material shall be left unrolled on the edge next to the adjoining lane. When the adjoining lane is laid the edges of the two lanes shall be rolled together so that no joint will be apparent.

10. Testing Finished Surface.—The surface shall be tested with a 16-foot straight edge laid parallel with the center line of the road upon any portion of the surface, and any variations from a true profile exceeding ¼ inch shall be satisfactorily eliminated.

Natural Tunnel Shelter in New Jersey

An underground air raid shelter is provided for more than the entire population of Mount Hope, N. J., by two 1,000 ft. tunnels in solid rock cut originally for removing iron ore, but long unused. The Township Defense Council is preparing these tunnels to serve this purpose.

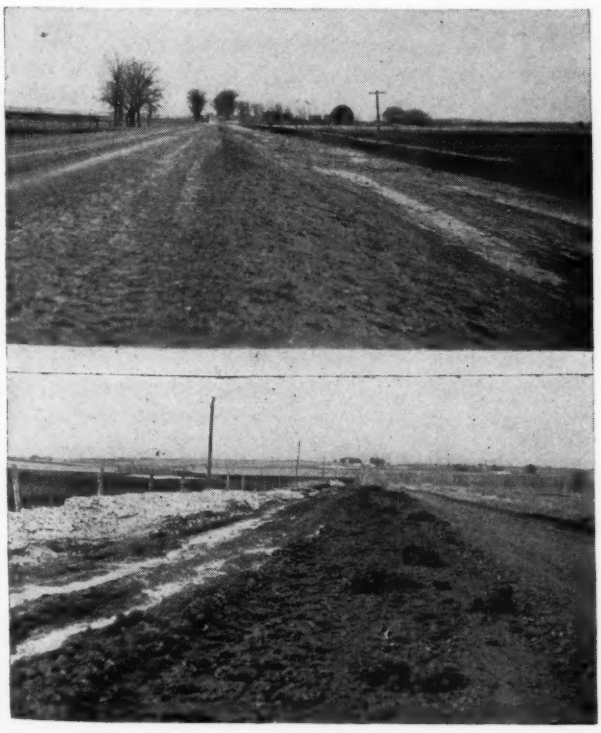
Spring Maintenance of County Roads

(Continued from page 12)

The best time to take care of these sod shoulders is the early spring as soon as the patrolmen can get out. If they cut the shoulders down and bring the dirt and sod in to the road at that time of the year, the sod will not ball up or interfere with the machine operation; and if it is dragged across the road a few times, the dirt will work into the gravel and act as a binder, giving a perfect surface from ditch to ditch. But, if this secondary ditch is not taken care of, although it may only be an inch or so deep at the time the patrolman cuts it, it will soon wash and may seriously damage the road.

In the spring, patrolling is, of course, the most important procedure for getting the highways dry. The sooner you start patrolling, the more quickly your roads will be dry. In patrolling, the mud and slush should be carried from one side of the road to the other to help the road dry out. In bad spring break-ups on dirt roads and on roads on which the gravel is too thin to support the patrol grader, we use a small crawler tractor and road drags. These drags we make ourselves in our shop out of a couple of "I" beams placed on a skew and held together with three cross beams. These drags are inexpensive as we use material left over from old bridges, and they are heavy enough to do a good job of patrolling.

Another important consideration in the spring is the opening of culverts. Culverts may be opened on the discharge end and the snow cleared from this end quite early. The inlet end of the culvert should not be opened until you can be sure that the water will run in sufficient amount and with enough speed so that it will not stand and freeze in the culvert. If a culvert does get full of ice, we have found that the best way to open it is to thaw it out with a steam boiler. This should be done preferably from the discharge end if that end is accessible.



Top—Sandlifts were put in nearly the full length of this road, which used to be impassable every spring. Below—County highway full of frost boils.

Collection and Disposal of Ashes and Trash

(Continued from page 19)

readily controlled. Grievances of citizens are more easily settled. Many questions arise that can be handled better by Township forces, such as whether a collection has been missed or the patron had neglected to put the material out in time, whether material is domestic or commercial waste, etc. The men and equipment are available for other services. They pick up papers and trash strewn along the street. In Lower Merion they are used to gather material collected by the motor sweepers, in emergencies to plow snow, spread cinders on icy roads, clean up debris at times of severe storms, and handle road maintenance on the off day, which is Monday. They also collect cans of screenings, three times per week, from the four sewage pumping stations. In summer months when ash collections fall off to practically nothing, the equipment and men are transferred to road maintenance work, and minor highway improvements or weed cutting, which at that time are at their height. The additional representatives of the Township on the street make it likely that the maintenance forces will be more quickly advised of needed road repairs. Frequently the foreman or men pass word to the Superintendent of Maintenance of holes developing in road surfacs. This would not happen if the collection was by contract. If complaints are a measure of the satisfaction of the service, there are a far larger number received on account of garbage collection, which is by contract, than for ash and trash collection, which is by Township forces.

The cost of operation is also a factor. With township forces the contractor's profits are eliminated. Both methods can be abused and costs can climb. In 1938 bids were taken for collection by contract, and one contractor bid within a few dollars of the Township cost for the year previous, while another bid ran fifty per cent above the Township costs. To the contractor's bid price would have to be added costs for inspectors and supervision. The contractor is more liable to slight the work than is a municipal superintendent.

It is generally accepted throughout the Township that the collection of waste material during the past ten years with Township forces has been very satisfactory. The service is excellent and the unit costs have decreased in spite of increased rates for wages.

The above is a paper presented at the Pennsylvania State Association of Township Commissioners' Convention at Harrisburg, March 31st, 1941.

Constructing the Whatcom County Airport

(Continued from page 23)

retarded somewhat due to intermittent delivery of materials to the project. A WPA Load-Lugger truck was used to advantage in distributing lighting cable from the reels. The reels were suspended from the hydraulic lifting arms on a steel shaft through the cable reels and unspooled along the trenches in a very short time.

The greatest difficulty in construction on this project was created by the heavy rainfall experienced from April, 1941 to the present. This required that plans be kept sufficiently flexible to permit revision of details as changing conditions dictated.

The airport runways are 500 ft. wide and have paved areas as follows:

Runway	*Length*	*Width*	*Type of Pavement*
Northeast-Southwest	5,000 Ft.	150 Ft.	Hot mix bituminous concrete
Northwest-Southeast	5,000 Ft.	150 Ft.	Dense graded portland cement base course
North-South	3,800 Ft.	150 Ft.	Dense graded portland cement base course

The North-South runway will be extended to full 5,000-ft. length next spring.

In the grading so far, a total of 1,300,000 cu. yds. has been moved at an average cost of 28c per cu. yd.; 188,000 cubic yards of peat were removed at an average cost of 51c per cu. yd.

In the drainage system, 53,318 linear feet of concrete drain tile was laid, the sizes ranging from 4" to 36"; 126 drainage inlets and catch basins were installed; 62,205 linear feet of underground lighting cable was laid; 95 boundary and range lights and 150 contact lights have been installed.

The 373 acres has been cleared of an exceptionally heavy second growth of miscellaneous varieties of trees over an area of previously logged ground containing numerous large fir and cedar stumps. Removal of the stumps necessitated the use of 28 tons of dynamite.

In the course of construction the maximum equipment used at one time was as follows:

12	12-yd. Carryalls	22	3-yd. dump trucks
6	90 H.P. or over, bulldozers	2	Motor patrols
2	2½-yd. shovels	1	½-yd. concrete mixer
1	1½-yd. dragline shovel	1	½ -sack mortar mixer
1	⅝-yd. combination dragline shovel and hoe	2	Power rollers
		8	Portable electric light plants
1	¾-yd. shovel in gravel pit	2	Rippers
8	5-yd. 6-wheel dump trucks	1	1,000-gallon water tank truck
5	8-yd. 6-wheel dump trucks		

A total of 26,300 bbls. of cement has been used in all operations to date. The total cost of all construction to date since March 18, 1940 is $913,408.93.

The project, at present, is employing approximately 115 WPA workers who are clearing the extension on the North-South runway and doing clean-up work, filling in ruts and installing contact lights and electrical equipment. Additional paving and seal coating of the completed runways will be done as soon as weather permits.

Garbage Dump Fires Prohibited

The Director of the California State Department of Public Health has requested all health officers to extinguish fires on garbage dumps, immediately, in order that "blackout" requirements may be met. Many garbage dumps are located in proximity to naval and military reservations and often they are kept burning night and day with smoke and fire visible for many miles. It is requested that the practice of burning on garbage dumps be forbidden.

The recommendation is made that all garbage be covered with at least two feet of earth and that deposits of garbage and refuse be covered daily. Facilities for extinguishing fires that might be started incidentally should be provided.

It is also important that intensive rodent control operations be maintained on all garbage dumps in order that the rat population may be maintained at a minimum. Such control measures are important in order that plague may not be permitted to spread among rodents.

Substitutes for Aluminum Paint

Materials recommended for use for many of the purposes for which aluminum paint is considered the most desirable.

ALUMINUM being one of the "critical" materials, the OPM releases aluminum powder and paste for paint only where aluminum paint is deemed essential and substitution is difficult. Information concerning substitutes has been prepared by E. F. Hickson, chemist of the National Bureau of Standards, and H. A. Gardner, chemical engineer of the Institute of Paint and Varnish Research, and is abstracted below.

"We know of no one paint that has all the desirable properties of aluminum paint for special uses, such as durability, visibilty, low emissivity, impermeability to moisture, reflectivity, opacity, etc." There are, however, a number of types of paint which possess the properties necessary for most individual purposes. The following are recommended where substitutes of aluminum are necessary. The numbers refer to Federal Specifications T. T.

For painting structural steel, such as bridges, tanks etc. the following is recommended: After priming the clean surface with a rust-resisting primer, such as red lead paint (P-86), basic lead chromate paint (P-59) etc., use a finish coat (instead of aluminum) of gray paint (or any other tint) conforming to Federal Specification TT-P-36a or TT-P-156. If chalk-resistant titanium oxide is specified, P-101a or War Department Cantonment Paint, Standard Specification 8000E, page 88, June 30, 1941, may also be used, tinted gray or any other desired color. If color is of no moment, dark-colored paints such as iron oxide (P-31a) or black (P-61) will be more durable than white or light-tint paints. The black and iron oxide paints will be just about as durable as aluminum paint. Additional information on painting structural steel may be found in National Bureau of Standards Letter Circular 422.

If light or heat reflectivity is the important factor, such as in the case of gasoline-storage tanks, then a white paint on a titanium-lead-zinc base (P-101a) may be used. This is a durable paint, but not as durable as aluminum paint.

To prevent bleeding of bituminous coatings, a good resin emulsion paint (P-88) is suggested for interior use, and has been used successfully out doors on Robertson (bituminous) protected metal.

Painting metal roofs.—On tin and other metal roofs where aluminum paint has been used increasingly of late, a good red metallic iron oxide roof paint (P-31a) should be used. Red lead paint (P-86) makes an excellent primer. Prepared metal paints made on a rust-inhibitive pigment base well serve the purpose.

Painting smokestacks, boiler fronts, etc.—A good grade of black asphalt varnish (V-51), a heat-resisting gray or black enamel, or certain of the proprietary heat-resisting compositions may be used.

Painting interior structural steel.—In industrial plants where good light reflection from the structural steel is desired, the following procedure may be used. Apply a priming coat of quick-drying red lead paint (Procurement Division Specification No. 358), followed by either two coats of eggshell flat white paint (P-51a) or gloss white enamel, sometimes called "mill gloss white" (E-506a). The enamel will be more water-resistant and more durable. For special conditions where fumes are encountered, such as in chemical laboratories, etc., a special enamel known as fume- and heat-resisting enamel (National Bureau of Standards Letter Circular 489) may be used.

Machinery and metal equipment.—A good machinery gray enamel (E-506a) may be substituted in many instances.

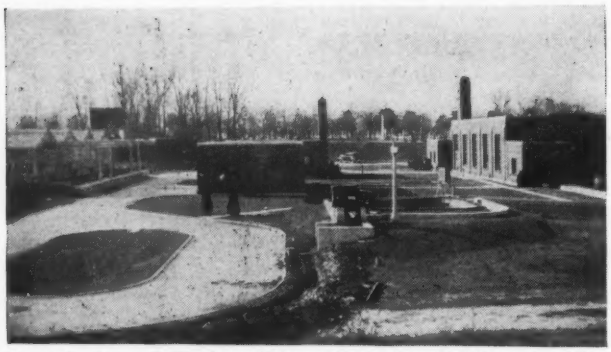
General considerations.—We have purposely avoided specifically recommending synthetic resin paints and enamels, because of the shortage of certain ingredients used in these paints. Similarly, certain highly durable cellulosic finishes could be employed, but the plasticizers and solvents for these are also developing an acute shortage.

Talc and mica-aluminum finishes.—In cases where is is believed essential to use some aluminum powder in order to produce an aluminum appearing finish, a great saving could be effected by employing mica or talc with the aluminum powder. As high as three parts by weight of mica or talc and one part by weight of aluminum powder may be stirred into a mixing varnish to produce a finish that has the characteristic aluminum appearance. This is in the proportion of two pounds of the total pigment (including the talc and aluminum powder) to one gallon of the mixing varnish. If the fine lining grade of aluminum powder (A-476, Type B) is used, as little as ½ pound of it and ½ pound of mica, suitable for paint, may be mixed with 1 gallon of varnish (V-81a) to produce a paint which is reported to have good durability.

Wherever Federal Specifications are referred to in this memorandum, they cover products which will be satisfactory for the usage referred to, but for the general buying public similar products may be obtained under trade brands at any paint store throughout the country. The paint dealer will readily recognize the material referred to.

The complete titles of the Federal Specifications referred to above are as follows:

Federal Specification No.—	*Title*
TT-P-86	Paint, red lead base; linseed-oil, ready-mixed.
TT-P-36a	Paints, lead-zinc base, ready-mixed, and semipaste, white and tinted.
TT-P-156	Paint, white lead base; basic carbonate, ready-mixed, light tints and white.
TT-P-101a	Paint; titanium-zinc and titanium-zinc-lead, outside, ready-mixed, white.
TT-P-31a	Paints; iron hydroxide and iron oxide, ready-mixed and semipaste.
TT-P-61	Paint; ready-mixed, and semipaste, black.
TT-P-56	Paint; (for) priming plaster surfaces (plaster primer and sealer).
TT-P-51a	Paints; oil, interior, eggshell-flat-finish, ready-mixed and semipaste, light tints and white.
TT-E-506a	Enamel; interior, gloss, light tints and white.
TT-V-51	Varnish, asphalt.
TT-P-88	Paint, paste, resin emulsion, interior, light tints and white.
TT-V-71a	Varnish; interior.
TT-V-81a	Varnish; aluminum mixing.
TT-P-59	Paint, international orange.
TT-A-476	Aluminum-Powder (for) paints (aluminum-bronze-powder).



General view of Findlay, Ohio, plant. Main building at right; sludge beds and digester at left.

The Sewerage Digest

Abstracts of the main features of all important articles dealing with sewerage and sewage treatment that appeared in the previous month's periodicals.

San Diego's Treatment Plant

Part of San Diego's sewage is discharged untreated into San Diego Bay and part through antiquated settling tanks into the Pacific Ocean. To relieve the insanitary condition created, a project was designed and is now nearing completion for building an intercepting sewer to collect all the sewage entering the bay and conduct it to a treatment plant. Because of the septic condition of the sewage, this large sewer is of reinforced concrete pipe lined on the upper two-thirds with glazed tile liners. Because of ample dilution, primary treatment only is considered necessary. The treatment will consist of odor control and/or sterilization, comminution, grit removal, pumping, aeration for flotation of scum and grease, vacuum removal of scum or grease, combined flocculation and sedimentation, measurement of effluent; digestion of sludge, scum and grease; sludge thickening, vacuum filtration, flash drying, storage of dried sludge. Air will be delivered into the aeration tanks through perforated pipe and a vertical propeller-type flash mixer. For removing scum and grease, two vacuum tanks maintain a 10 ft. vacuum by means of air pumps, and mechanism skims off scum and scrapes off sludge. These vacuators are expected to remove 30% of the suspended solids. The combined flocculation and sedimentation tanks are expected to remove 60% of the suspended solids, or 75% removal combined with the vacuators. Effluent is measured with 30" Parshall flumes and recording meters. For digestion there are two covered primary tanks and one secondary. The sludge will be thickened and elutriated. Sludge cake will be dried from 70% water content to 10% by flash dryers using digester gas. The outfall will have four outlets 45 ft. below high water 1200 ft. from the quay well. The cost is about $4,254,000. It is expected the plant will be completed this fall.[L4]*

Pickling Liquor In Treatment Plant

At Massillon, O., pickling liquor wastes from steel plants reach the treatment plant in slugs at irregular intervals, day and night, and in 18 months the impeller of the raw sewage pump was so badly eaten by the acid that it could not operate and was replaced with one using high-nickel iron. Also the chains of the sludge-removing equipment had to be replaced after 3½ years' use. The pickling liquor waste contained about 2% free acid and 4% iron. Partial relief has been obtained by neutralizing the acid with soda ash at the mill; which helped, but is not a satisfactory solution.[H11]*

Estimating Solids In Sewage Sludges

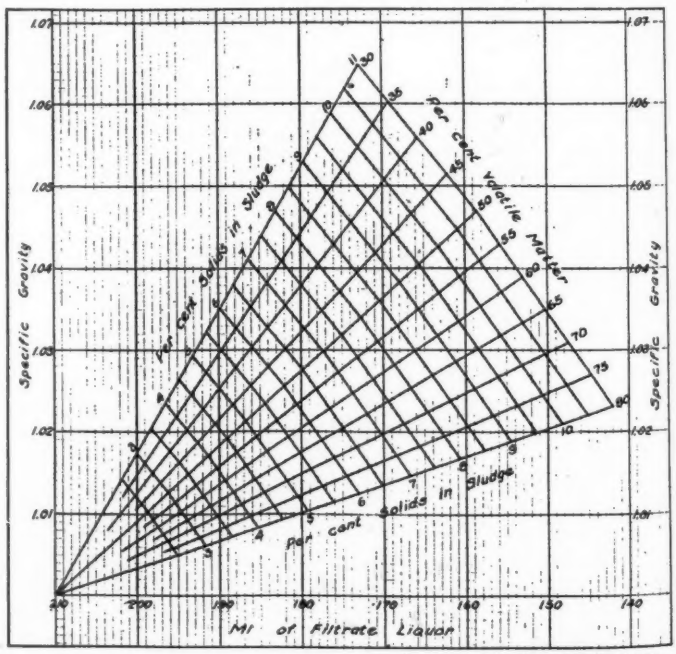
The Bird Island Laboratory (Buffalo, N. Y.) has developed a technique for determining sludge solids from the volume of filtrate liquor obtained by filtering a chemically treated sample, and a graphic relation between filtrate volume, per cent solids, per cent volatile matter and specific gravity. The data of interrelations of these factors, plotted on cross-section paper, produce lines within a wedge-shaped triangle, called the "sludge triangle." Tests of use of this triangle compared with the standard method show an average difference between the two of only 0.02% for total solids, and of 2.43% for volatile matter content. Perhaps a specific triangle would have to be developed for each type of sludge, especially for activated sludge.

It is possible, by use of the graph, to estimate any two characteristics of a sludge if the volume of filtrate liquor from vacuum filtration of a chemically treated sample, and either per cent solids, per cent volatile matter, or specific gravity, are known. A measured sample of sludge is treated with known quantities of lime and ferric chloride; the volume of filtrate resulting from vacuum filtration of the treated sample is measured, and the specific gravity of the sludge as sampled is determined. Both tests can be performed in ten minutes, after which the total solids and volatile matter content can be estimated with reasonable accuracy by use of the "sludge triangle" graph.

The sludge triangle can also be used to estimate per cent solids from volume of filtrate or specific gravity, if the approximate volatile matter content of the sludge is known. Or volatile matter may be estimated from the volume of filtrate liquor or specific gravity, if the total solid content is known.[G8]

The Guggenheim Bio-Chemical Process

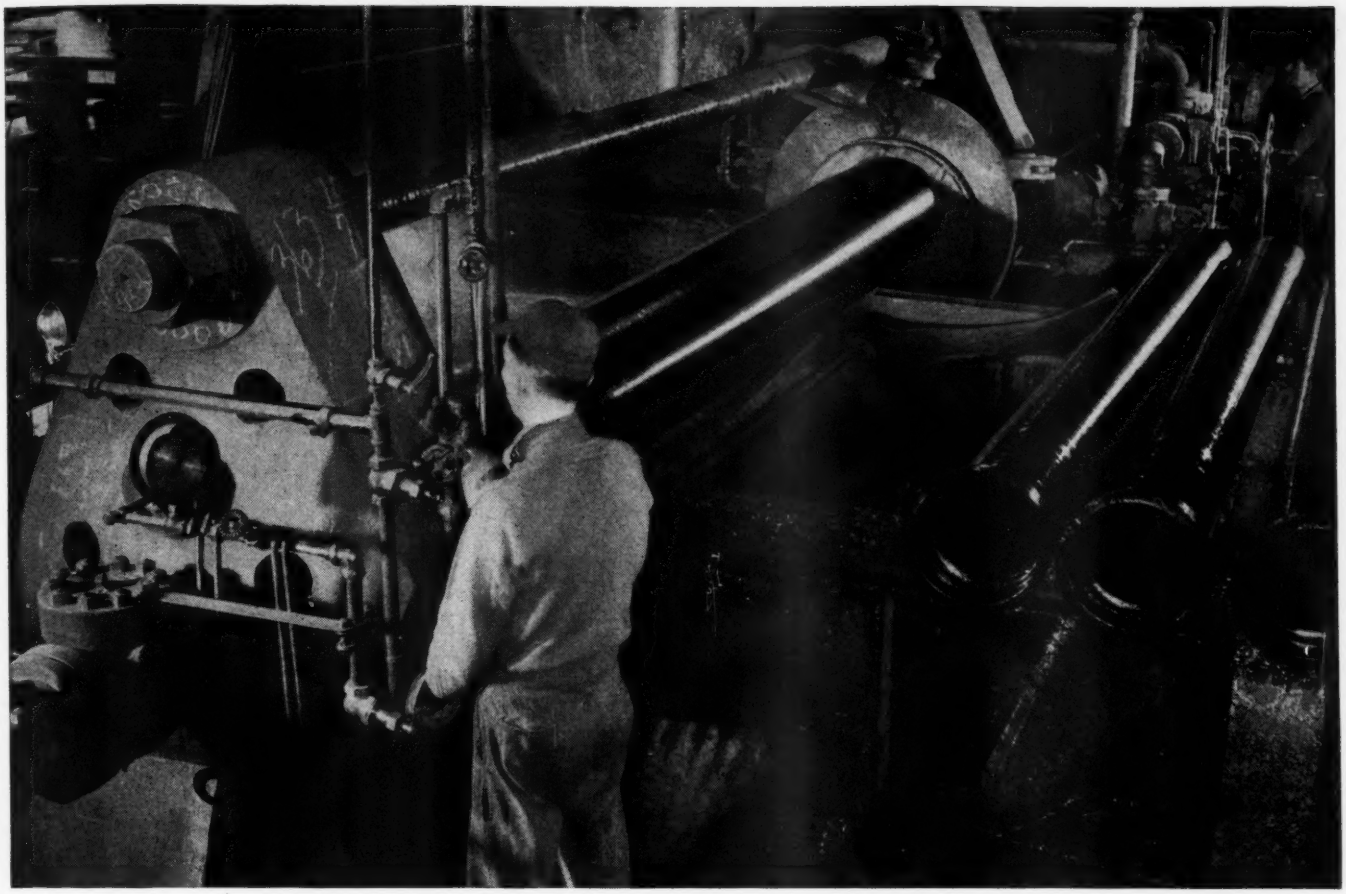
This involves the addition to the inflowing sewage of return sludge and a solution of ferric sulphate or equivalent coagulant; followed by aeration, sedimentation, dis-



Courtesy Water Works & Sewerage

The sludge triangle; a graph of interrelations of three sludge characteristics.

*See Bibliography in the February issue.



* The "Hydrostatic Proof Test," illustrated above, is an acceptance test for cast iron pipe. Every full length of pipe—whether for water, gas, sewer or industrial service—is subjected to this test before shipment. It is one of the routine tests made by this Company to insure that the quality of its pipe meets or exceeds the requirements of accepted standard specifications for cast iron pipe. *United States Pipe and Foundry Co., General Offices: Burlington, N. J.* Sales Offices in Principal Cities.

* One of a series of controls in operation at each of our plants, beginning with inspection and analysis of raw materials and ending with tests of the finished product, all subject to the central control of our headquarters staff at Burlington.

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charge of the purified supernatant, and return of a portion of the sludge. Laboratory experiments covering two years and using synthetic sewage showed that the presence of 5 to 10 ppm of iron stimulated the growth of *Aer. aerogenes* and, after conditioning, increased the rate at which it reduced methylene blue.

A pure culture of *Aerogenes,* fed intermittently with synthetic sewage and treated with ferric sulfate, developed an active sludge mass capable of performing rapid adsorption of soluble organic matter followed by oxidation of soluble and insoluble solids, at a much higher rate than that normally associated with that organism in the B.O.D. reaction.

In the presence of a mixture of activated sludge in pure culture with unactivated iron floc, adsorption goes largely to the iron floc to the extent that the activated sludge is prevented from performing its ordinary oxidizing function.

Given a continuous supply of normal sewage bacteria, the conditioning of the biochemical sludge is rapid, in 2 or 3 days reaching equilibrium with a sewage of 200 ppm B.O.D. and building up a mixed liquor of 1,000 ppm suspended solids. This biochemical sludge will, therefore, become established in preference to the activated sludge and will tend to restrain the development of the latter under the designated operating conditions. Its ability to adsorb more rapidly, together with the coagulating action of the freshly applied chemical, gives it an advantage over the slower acting sludge, which is reflected in practice in a reduced time requirement for aeration and consequent indicated economy in tank volume and in air.

The biochemical sludge appears to be more rugged and more readily generated than activated sludge, which may make this process valuable in the treatment of industrial wastes.[C14]

Composting Fine Screenings

New York's Jamaica and Hammels plants treat about 40 mgd, the fine screenings from which are passed through a centrifuge and come out as a cake with 65% moisture. To this is added 2% of gypsum (by weight) and 2% of straw (by volume), and the mixture is piled on the ground to compost. A temperature of about 150° F develops rapidly and after 30 to 60 days the material is chocolate brown in color, entirely devoid of offensive odor, loose in texture, resembling high-grade natural humus, contains about 80% organic matter, 2.5% nitrogen and 1% phosphoric acid. In one year the Park Dept. used 1600 tons of this as a mulch around trees and shrubs.[C11]

Natural Purification of River Muds

River muds contain considerably larger fractions of non-decomposable solids than are normally included in fresh sewage sludge, and these influence the course of decomposition. Among these effects is a difference in volume and rate of gasification, apparently due in part to decreased mobility of interstitial fluids and organisms, and to absorption (upon the enormous areas of the surfaces of the clay colloids) of ammonium salts and often compounds that contribute to alkalinity and buffering properties.

As river muds and pollutional sediments grow in depth, anaerobic decomposition becomes most active and releases to the sludge-water interface only remnants of the oxygen-demanding substances originally accumulated. Deposits containing more than 1 kg of volatile solids per square meter of surface probably will exert a benthal oxygen demand that is less than half the potential demand of the settleable solids discharged into the receiving water, unless the deposits are gas-lifted or otherwise resuspended. Most of the oxygen demand that is dissipated by anaerobic decomposition is liberated to the atmosphere as marsh gas. A balance can be struck in which the sum of the benthal oxygen demand, the oxygen equivalent of the nitrogenous compounds released to the supernatant water, the oxygen equivalent of the combustible gases liberated to the atmosphere, and the residual oxygen demand, must be equal to the ultimate oxygen demand of all the materials laid down.

Sludge banks may be resuspended and shifted in place. Fluctuating temperatures complicate the problem. But studies of a case of constant accumulation indicate that a reduced rate of oxygen demand accompanies the building up of deposits and that ultimately the rate of decomposition becomes equal to that of deposition. It follows that a maximum rate of oxygen demand equal to the demand of the daily increment or organic matter would be a safe engineering assumption under the conditions of sludge accumulation upon which this analysis is based.[C6*]

Experiences In Odor Control

Odors due to poorly digested sludge have been prevented in several New York towns by applying activated carbon to the sludge as it was removed to the drying beds, although at Brighton neither activated carbon nor chloride of lime gave more than temporary relief when applied to sludge in the bed. At Webster, over-long retention in the settling compartment of an Imhoff tank made the sewage septic and caused odors in the sprinkling filter. Chlorine was only a palliative, but odors were prevented by pumping well-oxidized supernatant from the final settling tank to the inlet of the Imhoff tank; this made it possible to carry a chlorine residual at the trickling filters with only half the chlorine dosage required without recirculation. In Brockport, foaming caused by accumulation of undigested sludge during the winter necessitated withdrawing undigested sludge, causing odors; remedy—withdrawing sludge onto the beds during freezing weather and removing it in frozen cakes in 24 to 48 hours. A similar condition at Fairport was remedied by heating the digestion tank with heat from the village incinerator. Odors in the wet well of a pumping station in Lawrence were eliminated by systematically scraping grease from the walls and sweeping accumulated solids into the pump suction; Imhoff tank settling channels are skimmed daily and gas vents hosed with plant effluent. In Wanakah, chlorination of raw sewage just above Imhoff tank inlets and scattering a mixture of 1 part activated carbon to 4 of lime over the gas vent scum prevented odors and gave a good drying sludge. Scotia finds that odor nuisance is prevented by using about half the amount of chlorine needed for sterilization, averaging (for average flow of 430,000 gpd) 45.5 lb. in May, 44.3 lb. in June and 47 lb. in July.[C7*]

"Step Aeration" Of Activated Sludge

In step aeration, activated sludge is returned from the final tanks to the head of the aeration tanks, and part of the settled sludge is added here and the rest at two additional points along its flow through the tanks. This decreases the high biological shock on initial contact with the sewage and supplies food to the sludge at a more uniform rate. It is used when there is persistent increase in volatile content of the activated sludge; when the sludge index is decreasing steadily or D.O.'s dropping steadily; or in case of high sphaerotilus growths. It is not used when primary effluent solids are low or flow is low, or when there is over-aeration as indicated by high D.O. and pin-point floc in the final effluent. Preliminary results from experiments indicated that if the sewage loading produced more than 3 hrs. aeration, conventional aeration was equal to or better than step aeration; but that the latter gave better results for shorter aeration periods, satisfactory results having been obtained with only a 1½ hr. period.[C11]

The above refers to the plant at Tallmans Island, where step aeration was developed by Richard H. Gould. About the same time the idea was advanced independently by G. M. Fair, and tried out in a laboratory plant; Mr. Fair calling the process "distributed loading," "multiple-point dosing" or "incremental dosing." His experiments indicated that load distribution provides a workable modification of the activated sludge process by maintaining oxygen demand at a more uniform level, producing an indigenous activated sludge with good purifying capacity and settling properties, discharging a good effluent without in-

*See Bibliography in the February issue.

creasing the air consumption, and effecting a saving in tank volume. It makes it possible to adjust the character of the sludge produced to the needs of the sewage treated, aids in control of bulking and blanket rising, and reduces the shock of sudden discharges of industrial wastes. It requires no special equipment and permits increasing the capacity of overloaded aeration units.[C15]

Operating Activated Sludge Plants

Conclusions of a committee of the American Public Health Assn., based on study of available literature and data, include the following: The first essential of operation of an activated sludge plant is adequate air supply. Another principle is keeping the oxygen demand of the mixed liquor as low as practicable. Operators of large plants gage performance by determination of B.O.D., suspended solids, dissolved oxygen, and settling properties of the activated sludge; also sometimes organic nitrogen, ammonia, nitrites and nitrates, and occasionally microscopical examination of sludge. Values of dissolved oxygen in the mixed liquor at the outlet of the aeration tank are found as high as 5 ppm, and 0.5 to 2.0 are considered the minimum permissible. Activated sludge high in ash is less likely to bulk, requires less ferric chloride, produces a cake of lower moisture content and B.t.u., and has lower fertilizer value. The optimum amount of solids in the mixed liquor must be determined by experience for each plant; the present tendency is toward lower values—1,000 to 2,000 ppm. The ratio of sludge return solids to incoming sewage solids varies from 10:1 to 35:1—usually between 10:1 and 25:1. Where excess activated sludge is digested, returning supernatant to raw sewage may cause trouble; in any case, the supernatant should be returned at as low and uniform a rate as practicable.

Nitrates in the effluent may cause algae growths in the diluting water. If there is always dissolved oxygen in the receiving stream, producing more than 1 or 2 ppm of nitrate seems unwarranted, unless for smaller plants as a safeguard to operation. Quick aeration of the effluent from final settling tanks, as by cascades, may be desirable to increase the dissolved oxygen, but how much satisfies B.O.D. is still subject to determination.

Plants receiving sewage low in iron have little trouble from diffuser plate clogging; but high concentrations, particularly in "shots" of pickling liquor, appear to cause such clogging. Pickling liquor and wastes from the manufacture of paint may inhibit bacterial action.[C10]

Odor Control At Wards Island

Sludge storage tanks at New York's Wards Island plant hold 188,000 cu. ft. and at times the odor in the enclosing building is terrific. The air is discharged at the rate of 15,000 cfm through activated carbon filters and given an application of 40 to 60 grams of ozone per hour, which adequately removes the odors, the filters removing 80% to 90% of the odors. Similar devices are used on the vessels carrying the sludge to sea, but the results of these are not so good because they are too small, and they have to be replaced frequently at considerable cost. Spray scrubbers and new types of carbon containers are being tried.[C11]

Operation In Cold Weather

In temperatures down to 50° below zero, sewers with only 2 ft. covering are free from frost action. Frost may heave paving but not manhole heads; in Ontario planks the shape of a manhole top are placed on it to level up the street. Catch basins fill with snow and freeze and are thawed by means of a portable steam boiler on a truck. Deep basins are less likely to freeze than shallow ones. Cold weather favors treatment by decreasing septic action in the sewers, and odor and other nuisances. Freezing interferes with the operation of air lines, entrance and outlet channels, sludge handling, etc., and most plants are covered in northern Canada. All sprinkling filters in Ontario are covered. Sewage in uncovered clarifiers freezes

and ice is broken and removed by hand. In activated sludge plants, piston compressors heat the air more than blowers, which is an advantage in cold weather, especially if there is moisture in the compressed air, when needle point valves are apt to freeze unless the air lines are submerged or they are sheltered from the wind.

When the drive mechanism of clarifiers operates on a track, sand on the track prevents trouble with ice. Sludge drying on open beds is impracticable in winter in most of Canada; the problem is met by covering beds, heating, winter storage, and removal in the liquid state. For heating glass covered beds, heating coils are being replaced with unit heaters which blow hot air against the sludge.[C20]

Cleaning Diffuser Plates

Experiments on cleaning diffuser plates were made at the Cleveland, O., plant, using nitric acid (36° Baume), muriatic acid (18° Baume), sulfuric acid (66° Baume), caustic soda, dichromate of soda, and gasoline. The sulfuric acid was converted to sulfuric-chromic acid solutions containing 2% and 5% dichromate of soda. The caustic soda was used as a 20% solution.

The sulfuric-chromic acid was the only one of these that restored porosity suitably, attaining 75 to 85% recovery of permeability. The others had some cleaning effect but no approximation to that of the chromic-sulfuric solution. In extreme cases, where the plates are heavily incrusted with iron and grease, preliminary treatment is required—caustic soda for heavy grease; prior soaking in muriatic acid for heavy incrustation of iron. Soaking one to two hours in the 2% dichromate solution, followed by draining and at least 10 rinsings in water is recommended.

The cost, when cleaning plates in lots of over 1,000, labor at 72.5¢ per hour, was 4¢ per plate for removing, 5¢ for cleaning, 4¢ for replacing, 9¢ for chemicals, 1¢ for rubber gloves and other equipment; a total of 23¢ per plate.

It was demonstrated that aluminum oxide plates can be removed from Burger type holders, cleaned and returned, with no appreciable loss from breakage, for less than 25¢; and that it is sound economy to clean diffusers when the blower discharge pressure increase equals 0.5 psi and the plate permeability has dropped to about 12. The question of how many times a plate can be cleaned before the porosity is permanently lost is still a matter for investigation.[C12]

Plankton as Indices of Pollution

The presence of *Chrysococcus* and *Cryptomonas* in large numbers indicates that decomposition of the organic matter in the stream has been completed by natural processes and the stream may be considered clean, but not necessarily suitable for domestic use without treatment.

The presence of large numbers of *Englena, Trachelomonas* and *Phacotus* indicates that the particular volume of water has been heavily polluted by organic matter farther up stream and that bacterial action has reduced the organic matter to available plant food. The plankton population gives a better picture of past history than of present sanitary condition.[C16]

Sludge Drying At Chicago Calumet

The Calumet sewage treatment works of the Sanitary Dist. of Chicago treats a sewage load equivalent to a population of 490,000. The sludge is dewatered on five vacuum filters, and then dried in three drying units, the larger part of the output of which is sold as fertilizer, the balance used as fuel in the dryers, one ton having the heat value of 85 gal. of fuel oil. In 1940, the average amount

produced per day was 26.2 tons of fertilizer and 1.7 tons burned; the dried product containing 93.2% solids, 4.70% nitrogen. An average of 2920 gal. of fuel oil was used per day. Odor nuisance is prevented by passing all waste vapor and gases through the high-temperature zone of the furnace.

For the vacuum filters an all-virgin wool cloth, 13 oz. per sq. yd., is found to be best, lasting five times as long as 8 oz. beer cloth, canton flannel and others. For decks, monel metal is found most satisfactory; but a corrugated wooden deck and rubber-covered iron wire mesh are being tried, and plastic materials are being tried. Plastic materials are being tried for the interior filtrate piping to combat corrosion, and also for the scrapers. Use of coated or covered iron wire for winding wire is contemplated. Grit in the sludge aids in filtration reducing the ferric chloride consumption and increasing the filter yield.

From 2.5 to 4 parts of dried sludge are mixed with one of filter cake before drying. In mixing these, severe abrasion occurs, especially in the paddle tips, for which Nihard alloy steel has proved successful. In the drying mill, severe abrasion occurs on the bars of the cage, for which renewable sleeves of special alloy steel are used. In the cyclone separators, the steel liner plates were abraded rapidly and have been replaced with gunite reinforced with galvanized steel mesh, using lumnite cement, which has reduced maintenance costs considerably.[H12]

Sewage Plants Constructed in 1941

During 1941, 637 sewage plants were under construction, some in every state of the Nation. Of these, 216 were at "defense" projects—army camps, air fields, military hospitals, shipbuilding yards, etc. Of the 637 561 were new plants, 7 replacements, 58 enlargements, and 18 repair projects. There are now about 5850 plants in municipal service and 216 in defense. Some 4377 of the plants are adequate. The 1941 plants vary in size from the giant projects of New York City to that at Luna Creek, Mo. with 202 population. Approximately 58,500,000 persons were served by sewage treatment facilities at the end of 1941, exclusive of some 2,000,000 served by defense works.[H13]

Grease in Sewage

Grease in sewage reaching rivers causes an extensive thin film that may interfere with purification by reaeration or with fish spawning, be objectionable to sight and impart unpleasant taste and odors. In treatment plants, grease tends to clog fine screens, form unsightly scum on tanks, interfere with sedimentation, deter biological processes, clog filters and nozzles, cause offensive odors, destroy paint, cause sludge to ignite when being dried, make dewatering more difficult, and reduce the value of sludge as fertilizer.

The present standard method of analysis is unsatisfactory for determining the quantity of grease in sewage, the results varying with the kind of solvent used. There is no agreement on what substances should be included in the term "grease."

A considerable proportion of the ether-soluble matter in sewage can be removed by sedimentation and plain skimming; a somewhat larger proportion if the sewage is aerated first; and still more with aero-chlorination. However, insufficient operating data are available to warrant a conclusion relative to the value of pre-aeration or of aero-chlorination in the over-all removal of grease from sewage.[K1]

Bibliography of Sewerage Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

C *Sewage Works Journal*
January

10. Operation and Control of Activated Sludge Sewage Treatment Works. Report of Committee of A.P.H.A. Pp. 3-69.
11. Operating Experiences in New York City. By R. H. Gould. Pp. 70-80.
12. Diffuser Plate Cleaning vs. Compressed Air Cost. By W. F. Schade and J. J. Wirts. Pp. 81-96.
13. Operating Costs in Fifteen Illinois Sewage Treatment Plants. By G. L. Farnsworth, Jr. and H. E. Babbitt. Pp. 97-103.
14. A Laboratory Study of the Guggenheim Bio-Chemical Process. By E. B. Phelps and J. G. Bevan. Pp. 104-120.
15. *t.* Load Distribution in the Activated Sludge Process. By J. E. McKee and G. M. Fair. Pp. 121-146.
16. Biological Zones in a Polluted Stream. By F. J. Brinley. Pp. 147-159.
17. Standards and Criteria of Sewage Plant Operation. By C. G. Hyde. Pp. 161-164.
18. Biological Filters. By M. W. Tatlock. Pp. 165-170.
19. Operation of Sludge Digestion Units. By G. E. Griffin. Pp. 170-175.
20. Cold Weather Operation. By A. E. Berry. Pp. 176-181.
21. Maintenance of Sewage Treatment Plant Equipment. By R. C. Hageman. Pp. 184-196.
22. Minneapolis-St. Paul Sanitary District. Operation Report. Pp. 199-206.
23. Three Gadgets—Liquid Depth Sampler, Sludge Grinder, and Lawn Sprinkler. Pp. 207-212.

D *The Surveyor*
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7. Digestion and Drying of Humus and Activated Sludges. Discussion of D4. Pp. 217-218.

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8. Mechanical Flocculation of Sewage. By J. Hurley. Pp. 15-16.

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9. *p.* Sewage Treatment Problems in Cold Climates. By A. E. Berry. P. 31.

G *Water Works & Sewerage*
January

6. The Sludge Triangle. (Rapid Method for Determining Sludge Solids.) By G. E. Symons and S. R. Kin. Pp. 17-23.

H *Sewage Works Engineering*
February

12. Sludge Drying and Fertilizer Production at Chicago Calumet. By L. M. Johnson. Pp. 67-71.
13. 637 Sewage Plants Under Construction During 1941. By Morris M. Cohn. Pp. 74-86.

J *American City*
February

3. Heavy Industrial Load Outranks Domestic Sewage. Pp. 52-53.
4. New Sewerage Laws Simplify City Financing in State of Washington. Pp. 58-59.

K *Proceedings, Am. Soc. of Civil Engineers*
February

1. The Grease Problem in Sewage Treatment. By Almon L. Fales and Samuel A. Greeley. Pp. 193-209.

L *Civil Engineering*
February

5. *p.* Buffalo Sewage Works Has Modern Laboratory. By G. E. Symons. Pp. 95-98.
6. Sewer Design by Approximate Flood Routing as Applied to an Army Cantonment. By R. Lee Fraser. Pp. 102-103.

M *Water and Sewage*
January

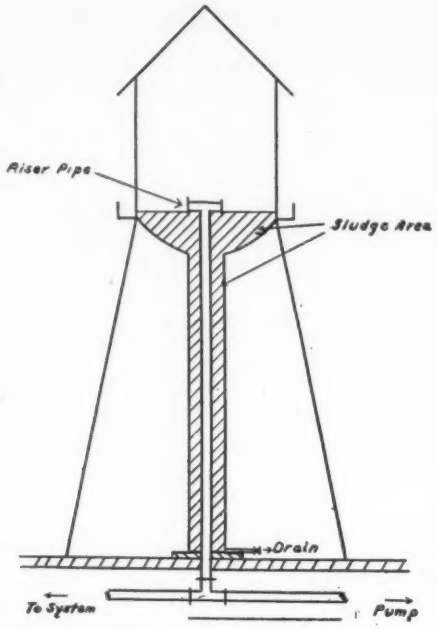
4. Details of Design That Affect Sewage Plant Operation. By C. E. Schwob. Pp. 12-14.

P *Public Works*
February

7. Third Year of Sewage Treatment Operation at Buffalo, N. Y. By Chas. R. Velzy, John W. Johnson and Geo. F. Symons. Pp. 26-30.

X *Journal, Missouri Water & Sewerage Conference*
January

2. The Maintenance of Sewerage Systems. By H. H. Chaffee. Pp. 38-42.
3. Paints in Sewage Treatment Plant Maintenance. By F. D. Travis. Pp. 43-44.
4. Some Phases of Sewer Operation and Maintenance. By W. B. Rollins. Pp. 45-46.
5. Continuous Maintenance of Treatment Plants. By G. L. Loelkes. Pp. 47-49.
6. Maintenance of Sewage Pumps, Sludge Pumps, and Their Auxiliary Equipment. By P. F. Morgan. Pp. 50-55.



Richmond, Va., standpipe used as a sedimentation tank.

The Waterworks Digest

Abstracts of the main features of all important articles dealing with waterworks and water purification that appeared in the previous month's periodicals.

Iron Sludge Settled in Elevated Tank

Richmond, Va., furnishes to a small community a domestic supply of water containing 10 ppm of iron, 41 CO_2 and 6.0 pH, which it treats by adding 200 lb. per m.g. of caustic soda and 8.34 lb. of chlorine, reducing the iron to 0.01, the CO_2 to zero, and increases the pH to 9.0. This treatment removes the heavy floc without the expense of aeration; eliminates CO_2 and prevents corrosion; eliminates sulfuretted hydrogen, and gave residual chlorine. The two solutions are mixed and fed through one feeder.

There had originally been provided a 30,000 gal. elevated tank with dished bottom and 36″ riser pipe, and this was used as a sedimentation tank to reduce cost. A small riser pipe was set inside the 36″ pipe, extending from the main to 5 ft. above the bottom of the tank, and the sludge accumulated in the 36″ riser and in the bottom 5 ft. of the tank. Water was pumped into the tank for a short time after 9 P.M., when there was little consumption; a mercoid time switch starting it and a pressure switch stopping it when the tank is full. All the sludge settles out by morning. About once a week the sludge is drawn off through a drain valve at the bottom of the 36″ pipe. This and weekly filling of the chemical crock are about the only attention needed.[G7]

Lead Hazard in Drinking Water

Safety in the use of lead service pipe depends upon the deposition of a protective coating inside the pipe; if this is dissolved by the water carried by the pipe the safety is eliminated. Tests were made on the solubility of lead carbonate and of lead sulfate in dilute solutions of materials used in water treatment. Compared to the solvent action of distilled water, chlorine up to 100 ppm showed less; sodium chloride and ammonium nitrate at 100 ppm showed the same; calcium hydroxide up to 25 ppm showed the same, but at 1,000 ppm showed much greater solvent action. Alum and ferrous sulfate up to 5 ppm showed no increase, and at higher concentrations the solubility of lead sulfate decreased but that of basic lead carbonate increased appreciably. Metaphosphate and pyrophosphate up to 10 ppm showed decreased solubility, and not until a concentration of 1,000 ppm was used did they show a strong solvent action.[A32]

Attrition Loss of Carbonaceous Zeolites

Carbonaceous zeolite has physical properties decidedly different from those of the other zeolites, and tests for attrition loss satisfactory for some other water softeners might not be adapted to these. An accelerated laboratory attrition test has been developed to evaluate comparative service characteristics of carbonaceous zeolites, based on agitating weighed quantities of the zeolites vigorously in water for 4 hrs. and then determining the turbidity of the solution by means of a Jackson turbidimeter. The turbidity is a measure of the attrition loss and indicates the durability of the zeolite in service.

Another method is to weigh the screened fractions of fine material after agitating and calculate attrition values by formulas that are given.

Turbidity and attrition numbers were found for each of 16 carbonaceous zeolites made from a wide variety of bright, splint and cannel coals. Correspondence between turbidity and attrition values appears to be good, so either may be used as a criterion in evaluating service characteristics.[A33]

St. Louis' Saddle Sleeve Connections

St. Louis, Mo., having had trouble with leaking saddle sleeve connections laid where it was impossible to recaulk the throat joint, now uses a cut rubber gasket 5/8″ thick and 1″ wide, placed in the throat of the saddle next to the main. Four set screws on the back side of the saddle hold it in position and it is then drawn up in the back, placing the rubber gasket in compression. The entire saddle joint is then poured with lead and the exposed lead is caulked but no caulking is required at the throat of the saddle, where it would be most difficult to use a caulking tool.[X10]

Wartime Emergency Reservoirs

For fire fighting when mains are broken or inadequate, London uses three types of special local reservoirs—tanks erected above ground, waterproofed basements of bombed-down buildings, and reservoirs dug on the site of demolished buildings. Tanks of the first type are generally made of steel plates bolted together, rectangular in shape, 4½ ft. deep, 7 ft wide and of various lengths. Circular containers of waterproof canvas also are used, but do not often fit into the area available. In waterproofing a cellar or basement, weak points in wall and floor are filled and strengthened, the floor sloped to a sump near a point convenient for the pump, and the inside waterproofed, generally with felt and tar or asphalt. The reservoir is surrounded with a fence to prevent accidents. In lining a dug reservoir, the banks are sloped and they and the bottom covered with bricks (generally old ones from bombed buildings) laid dry with open joints; then covered with a rich cement mortar distributed through hose and thoroughly brushed in. In all types of reservoir, copper sulphate is applied to prevent the water becoming foul.[F8*]

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 55-57

Control of Cross-Connections

Tennessee and New York permit cross-connections with automatically chlorinated supplies. In both states the use of fire pump chlorinators is approved only under special conditions where the source of auxiliary supply is not so grossly polluted that the water cannot be effectively chlorinated and, further, only in conjunction with the use of the approved type of all-bronze double check valves properly installed and equipped. In New York, although chlorination of the auxiliary supply is considered as rendering it legally "potable," chlorinating equipment is installed on the secondary supply, starting automatically when this secondary supply goes into service, which further reduces the cross-connection hazard; but even this protection is not equal to that provided by complete severence of the two supplies. In Utica, N. Y., daily reports to and frequent inspections by the water or health authorities reduces the hazard.

Separate fire mains are reported from 23 cities. Four are private; in one city, hotel fire pumps derive their supplies from deep wells; in 8, the high-pressure systems use safe water; ten use unsafe sources in separate fire mains, but in only two of them are the fire and domestic systems cross-connected, and then through double check valves.

The Committee on Cross-Connections recommends that no new cross-connections be permitted between potable and non-potable or unapproved supplies, and that existing cross-connections be eliminated as soon as possible; or, where this is impracticable, connections should be made only through approved, all-bronze, double check valves, properly installed, regularly tested, periodically and thoroughly inspected, and cleaned and repaired when necessary. Where a private potable supply not cross-connected to a non-potable one is connected to a public main through a service pipe, use of double check valves on the service might be considered if such could be developed. High-pressure public fire systems carrying non-potable water should have no connection with the domestic supply mains. Fire protection programs should not include pumping from polluted sources into public mains through hydrant connections.[A24]

Handling Activated Carbon

The method of handling activated carbon at the purification plant of the Southern California Metropolitan Water District is unusual. To eliminate the dust nuisance and fire hazard, the carbon is stored in a water suspension in circular concrete tanks about 300 feet from the head house. Upon delivery, the carbon is dumped immediately into the tanks, each having a capacity of a carload of carbon, and made up into a water slurry of known strength. Diaphragm pumps controlled by the raw water meters transfer the carbon to the points of application. Each tank is provided with a bag opener, mechanical agitator, and dust control devices. So far, this method of handling carbon has proven very satisfactory.[U2]

Massachusetts State Emergency Plan

This plan is organized to function under the governor of the State in any emergency. It operated during the 1938 hurricane and has since been expanded to include advice and assistance of all state and municipal departments, and military, civic and welfare organizations. The chief engineer of the State Dept. of Public Health is a member of the staff, and leading water supply officials of the state are civilian members with the title of water supply coordinators. Through these coordinators the water supply systems of the state have been adequately mapped, material and equipment are being inventoried, and facilities are being provided for mutual aid between water depart-

ments. Two civilian coordinators have been appointed from the ranks of water supply material manufacturers to assist in procurement and distribution of equipment, materials and chemicals. It is planned to set up a State Emergency Depot containing emergency stocks of chemicals, to be held for emergency use, to supply chemicals to any water utility that can not obtain them elsewhere to meet an immediate necessity, until they can be obtained from normal sources.[B2]

Emergency Preparedness

The Committee on Water Works Emergencies of the NEWWA, in a report occupying 28 pages, discusses the subject under the general classifications of "Pre-Emergency Safeguards," "Emergency Measures" and "Post-Emergency Measures"; subheadings of the first being: Source of supply; Pumping stations; Treatment plants; Distribution storage; Distribution piping; Construction of distribution system; Training of personnel; and Emergency equipment. Subheads of the second part are: Local coordinating committee; Use of emergency sources of supply; Transportation of water; Power interruption; Segregating portions of distribution system; Quality of water; Emergency notice to boil water; Emergency disinfection; Treatment of line breaks; and Aid available to other organizations. Part III discusses the "Return to normal."

In the letter of transmittal the chairman said: "We depend a lot on automatic devices and equipment. What is most needed in emergencies is automatic *personnel*."[B5]

Bibliography of Waterworks Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

A — *Journal, American Water Works Ass'n.* *January*

22. A Bit of Hydraulics, Psychology and Common Sense. By D. R. Taylor. Pp. 1-10.
23. Water Supplies for the Army. By W. A. Hardenbergh. Pp. 11-16.
24. Cross-Connection Control. Committee Report. Pp. 17-36.
25. Legal Responsibility of Minnesota Municipalities for Polluted Water. By O. C. Peterson. Pp. 37-52.
26. Some Legal Aspects of Sewage Treatment. By G. Jones. Pp. 53-55.
27. State Engineering Aid to New Mexico Municipalities. By W. C. Powell. Pp. 56-58.
28. Maintenance and Protection of Elevated Water Tanks. By H. F. Stearns. Pp. 59-62.
29. Maintenance of Elevated Tanks and Standpipes. By C. J. Leary. Pp. 63-68.
30. Grounding Connections to Water Pipes. Committee Report. Pp. 69-75.
31. *t.* Corrosion Study of Bolting Materials and Coatings. By O. A. Halvorson. Pp. 76-84.
32. Lead Hazard in Drinking Water. By C. C. Ruchhoft and J. F. Kachmas. Pp. 85-93.
33. *t.* Accelerated Tests for Determination of Attrition Loss of Carbonaceous Zeolites. By S. J. Broderick and E. S. Hertzog. Pp. 94-106.
34. Rehabilitation of the Philadelphia Water Works. By S. M. Van Loan. Pp. 107-116.
35. Meter Maintenance Practice. By A. P. Kuranz. Pp. 117-120.
36. Comprehensive Survey of Large Meters in Nashville. By R. L. Lawrence, Jr., and A. R. Sharp. Pp. 121-129.

B — *Journal, New England Water Works Ass'n.* *December*

1. Water Supply in War Time. By John Bowman. Pp. 483-488.
2. State Emergency Plan of the Commonwealth of Massachusetts. By Arthur D. Weston. Pp. 489-515.
3. Water Works Operations Under Emergency Conditions. By Harry E. Jordan. Pp. 516-521.
4. Water Charges to Municipalities in the Boston Metropolitan Area by the Metropolitan District Commission. By Karl R. Kennison. Pp. 522-560.
5. Water Works Emergencies. Report of Committee. Pp. 598-625.

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4. Water Supply in Air Raids (in England). Pp. 54-55.

F — *Water Works Engineering* *January 28*

13. Operating Results at Lancaster, Pa. By N. N. Wolpert. Pp. 76-80.
14. Relation of Copper and Brass Pipe to Health. By F. E. Hale. Pp. 84-86.
15. Clearing Wells with Plunger of Compressed Air. Pp. 87-89.

16. Water Supply Protection in U. S. Coastal States. Pp. 90-91, 102.

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17. Power Costs Reduced 90%. By Wm. H. Gottlieb. Pp. 130-132, 136.
18. Wells Under Reservoir Supply City. By H. F. Irwin. Pp. 135-136.
19. Open Well Development Method. Pp. 137-138.
20. Relation of Copper and Brass Pipe to Health. By F. E. Hale. Pp. 139-141, 156.

G *Water Works & Sewerage*

January

8. Developments of the Year in Water Supply. By R. Newsom. Pp. 1-16.
9. Tank Reduces Peak Pumping Loads and Insurance Rates at Jonesboro, Ark. By L. M. Rebsamen. Pp. 24-27.
10. *p.* Iron Removal for Small Systems. By H. E. Lordley. Pp. 28-30.

J *American City*

February

6. Glass Features Construction of Toledo Filtration Plant. Pp. 40-42.

K *Proceedings, Am. Soc. of Civil Engineers*

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2. Unusual Events and Their Relation to Federal Water Policies. By W. G. Hoyt. Pp. 211-224.
3. Reduction of Mineral Content in Water With Organic Zeolites. By R. F. Goudey. Pp. 225-236.

M *Water and Sewage*

January

6. Progress and Prospects in Water Supply and Sewerage Works. By A. E. Berry. Pp. 7-10, 38.
7. Unusually Elaborate Water Treatment. (So. California Water Dist.) Pp. 11, 46.

P *Public Works*

February

10. Protecting and Repairing Municipal Services in War Time. By Joseph D. Lewin and M. J. Popper. Pp. 13-20, 41.
11. *n.* Triple Water Supply for Ordnance Plant. P. 24.

U *Taste and Odor Control*

January

2. Soft Filtered Water for the Cities of the Metropolitan Water Dist. of Southern California. By W. W. Aultman. Pp. 1-7.

X *Journal, Missouri Water & Sewerage Conference*

January

9. Development of Ground Water from Wells. By E. W. Bennison. Pp. 20-26.
10. Some Metropolitan Water Distribution Practices. By M. Serkes. Pp. 27-37.

Sodium Silicates as Corrosion Inhibitors

Sodium silicates have been used as corrosion inhibitors for many years in small water systems and their use in an entire water system to prevent lead poisoning was recommended and used as early as 1886. A revival of this practice by Thresh about 1920 led to the observation that the corrosion of iron was reduced greatly also. Several municipalities in England found that corrosion of ferrous pipes was greatly reduced by adding a sodium silicate. About the same time Speller found that the same material was effective in hot water and developed a special method of feeding.

The protective action is due to a film formed on the metal surface either by chemical or colloidal action. The film forms slowly so the protection gradually builds up. The use of eight parts per million of SiO_2 for ninety days gives good protection in many waters, then the feed can be cut in half. Although the film persists for a while after no more silicate is added, it is better to feed a reduced amount continuously than larger amounts intermittently.

At least three forms of silica exist in water and in sodium silicate solutions and they are not equally effective in preventing corrosion. The difference is due to the degree of hydration and the length of the silicon-oxygen chain. The most effective form of silica in the prevention of corrosion is the intermediate one, which does not give the ammonium molybdate reaction until it is treated with an alkali.

The silicate treatment is most advantageous for very soft waters, salt waters, and brines. With salt present, more silica is needed to give protection but the maximum has not exceeded 40 ppm. *Abstract of a paper by William Stericker before the Engineers Society of Western Pennsylvania.*

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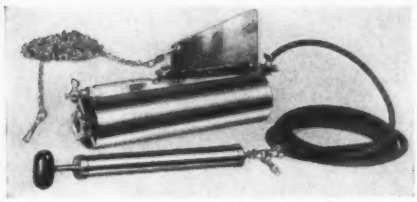


P.F.T. Sewage and Sludge Sampler.

Sewage Sludge Sampler

Pacific Flush Tank Co.
4241 Ravenswood Ave., Chicago, Ill.

A convenient device known as the P.F.T. Sewage and Sludge Sampler for sampling still or flowing liquids without disturbing the liquid bodies or contaminating the samples, has been introduced by the Pacific Flush-Tank Company, 4241 Ravenswood Ave., Chicago, manufacturers of sewage treatment equipment exclusively.

The unit consists essentially of a metal cylinder with an inflatable rubber valve at each end supported at the axis of the cylinder. On the one side of the unit is a sample withdrawal cock and a vent cock.

The sampler can be used in a vertical position, being passed through the well or hand hole of a digester floating cover or septic tank or it can be used in horizontal position to take a sample from an Imhoff Tank or flowing stream. In this case, a detachable guide fin is used.

The valves at both ends, which inflate in unison, are closed, after which the unit is lowered by means of a chain to the desired depth in the medium to be sampled.

The liquid is allowed to flow through the cylinder for a few moments and the valves are again inflated, closing both ends of the unit. A hand pump, supplied, is used and air passes to the balloon valves through a rubber hose. After the valves are inflated, the sampler is lifted to the surface and taken to a laboratory or elsewhere for removal through the draw-off cock.

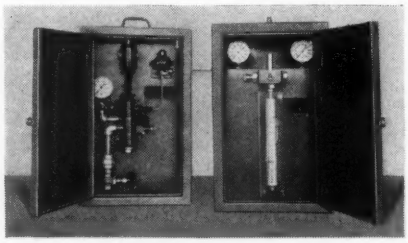
Construction is simple and rugged. All parts are accessible for cleaning or replacement. A new bulletin, No. 133, giving complete details, will be sent on request to the Pacific Flush-Tank Company.

Portable Chlorinator for Emergency Protection

Wallace & Tiernan Co., Inc.
Belleville, N. J.

A new portable chlorinating unit designed to meet emergency calls quickly and efficiently has just been introduced by Wallace & Tiernan Co., Inc., Belleville, N. J. Indispensable for emergency protection, the new unit has continual usefulness at all times for dead-end flushing, main sterilization, and other chlorination needs away from the plant.

Wherever a source of water at sufficient pressure to operate an injector is available, the new portable unit provides for a well-diffused solution feed. Other conditions can be met by gas feed. In each case, the rate of application is accurately maintained by use of the compensator control, which overcomes the effect of pressure changes in the chlorine cylinder.



Wallace & Tiernan Portable Chlorinator.

The unit is available with different orifice meters for standard capacities of 25, 75, 150 and 300 lb. per 24 hrs. solution feed and 25, 75, lb. per 24 hrs. direct feed. Rates of feed within each of these capacity limits can be adjusted over a 7 to 1 range. The equipment is supplied complete in three cases for convenient portability: (1) meter device and compensator, (2) injector and check valve assembly, (3) accessories and tools for making main connections. In operation, the chlorinator cases may be set up on a table or bench, or hung on a wall or pipe stand.

For complete information and specifications on the new Portable Chlorinator, write W&T for Technical Publication No. 231.

Early Strength Cement

Calcium Chloride Assn.
4145 Penobscot Building
Detroit, Mich.

With "speed" the keynote of wartime construction every man who works with concrete should have a copy of the Calcium Chloride Association's latest publication on "Early Strength Concrete."

This new 64-page manual tells how to speed up year-round concreting, shows how to secure high early strength and greater workability at temperatures either below or above freezing. It gives latest data developed at the National Bureau of Standards on the effects of low temperatures and explains how to offset the retarding action of cold weather. The book contains authoritative research papers and many actual examples of practical concreting operations, and is well illustrated with more than sixty photos, charts, graphs and tables.

Copies of this concreting handbook may be had without charge by asking the Calcium Chloride Association for Bulletin No. 28.

Sterozone Purifies Los Angeles River Water

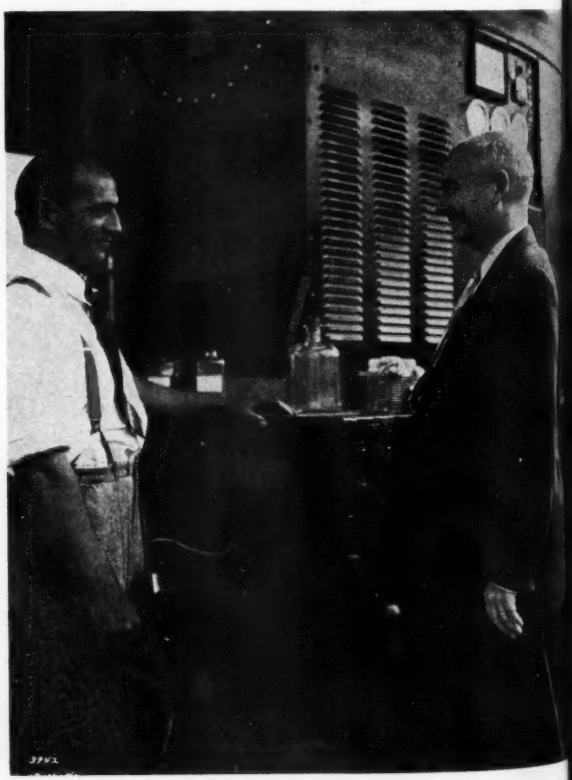
Technicraft Engineering Co.
Los Angeles, Calif.

Don K. Allison, Technicraft Engineering Co., receives congratulations from R. F. Gondey, Chief Sanitary Engineer of the Los Angeles department of Water and Power, on the performance of the Sterozone in purifying Los Angeles River water. The Sterozone pumps raw water through filters and into an absorber tank. Ozone, generated in the unit, oxidizes the bacteria. The discharged water is both colorless and tasteless.

Barricade Walls for Protection Against Bomb Splinters

Armco Drainage Products Association
Middletown, Ohio

The Pearl Harbor episode with the destruction of an untold number of airplanes on the ground has led to suggested splinter protection measures. One such suggestion advanced by the Armco



Los Angeles' Sterozone unit.

Drainage Products Association and the Armco International Corporation, Middletown, Ohio, is the use of bin-type metal retaining walls arranged in various layouts.

These walls, set vertically and to any height required, not only give ample protection against bomb splinters, but they have the advantage of occupying a minimum of valuable space; they are quickly installed by unskilled labor, or dismantled and stored in a minimum of space. They are literally "metal sandbags" but are much more permanent and otherwise advantageous.

Metal barricade walls are not entirely a new idea. Hundreds of them have been installed at ordnance plants in this country to isolate any possible blasts and to protect adjoining buildings.

Drawings and photographs showing the construction of these barricade walls may be obtained by addressing the Armco Drainage Products Association or any of its member companies.

Hot Poured Rubber Sealing Compound

Servicised Products Corp.
6051 West 65th St., Chicago

The manufacturers claim that this compound completely waterproofs any crevice or joining of two sections of concrete slabs. It is known to the trade as PARA-PLASTIC Compound. It is said to liquefy readily on heating so it can be poured, set and ready within the hour. It is not affected by cold or heat; bonds firmly with the concrete and maintains a perfect seal under all conditions of expansion or contraction of the concrete slabs. The tenacity and durability of PARA-PLASTIC is claimed to have been outstanding and known to extend to ten times its original thickness. Complete information available from the manufacturers.

Maintaining Public Relations During War Times

West Virginia Pulp and Paper Company
Industrial Chemical Sales Division
230 Park Avenue, New York, N. Y.

Many water plants throughout the country have adopted the precautionary measure, during the present emergency, of barring all visitors from water treatment plants. Such policies directly affect educational groups such as high school classes, college classes, nurses, etc.

In order to maintain satisfactory public relations, it is suggested that water plant officials take advantage of movie films which describe water treatment processes in general. One such film entitled "Behind the Water Tap" is made available, without charge, to any water works official. This movie is on 16 mm. colored silent film and is shipped on 3—400 ft. reels. Time of showing is about 35 minutes.

In requesting the loan of the film, it is desirable to specify alternative dates since requests will be handled in the order in which they are received.

"INFILCO Incorporated"

New Name for International Filter Co.

Organized 48 years ago, during the pioneering age of water purification, Infilco's early activities were in the design and development of filters and filter plant equipment. Thirty years ago, the company started the manufacture of water softeners and other water conditioning equipment.

Today with its products including sewage treating equipment—as well as equipment of every type and size needed to meet modern requirements of water conditioning—the officials felt the company should have a name of broader scope.

The name "INFILCO Incorporated" was the natural selection, says P. N. Engel, President. "Infilco," the streamlined abbreviation of the old name, was adopted as a registered trademark more than 10 years ago when 60 or 70 per cent of equipment manufactured then was already other than filters.

Small Portable Washing Plant

Iowa Manufacturing Co.
Cedar Rapids, Iowa

A small portable Washing Plant is illustrated and described in a single sheet specification bulletin issued by the Iowa Manufacturing Company of Cedar Rapids, Iowa. This addition to the well known Cedarapids line is built to handle small jobs that require washed aggregates. The bulletin gives complete details and specifications. Write to the manufacturer for copies.

Data Book on Sewage Plant Sprinkling Filters

Pacific Flush Tank Co.
4241 Ravenswood Ave., Chicago

Design data covering sprinkling filters of Separate Nozzle Field & Common Nozzle Field design is given as well as complete data on single and twin dosing tanks, and the various types of siphons used in them, for apportioning sewage to the nozzles.

Comprehensive charts and tables to assist the consulting and sewage plant engineer in rapidly computing the required filter bed area for a given loading and recommended nozzle spacing are included.

A section deals with the four types of circular spray sewage nozzles of P. F. T. design. Another discusses small trickling design for small communities and large institutions.

Write for Filter Data Book No. 130.

Dorr Biofiltration System for Pearl Harbor

The Dorr Company
New York, N. Y.

The Dorr Company has received an order, carrying an A-1a priority rating for sewage treatment equipment for a plant to serve the U. S. Naval Hospital at Pearl Harbor, Hawaii. It is to be of the Biofiltration type, design capacity 2000, and will consist of a Dorr Clarigester, combining primary sedimentation and sludge digestion, a Dorrco Distributor for a circular trickling filter, a secondary Dorr Clarifier and various pumps and other accessories. Every effort is being made to expedite shipment. One week after receipt of the order 22 new drawings for the job had been completed and manufacture orders had been issued to the shops.

Stuart J. Saks Elected President Morris Machine Works

Mr. Saks is a graduate of Syracuse University; and following an extensive sales and management experience, has been associated with the Company for the last two and one-half years as Assistant to the President.

Special Train to American Water Works Association Conference

Chicago—June 21-25, 1942

The train that has been selected out of New York for the Conference is the "General" of the Pennsylvania Railroad, leaving New York Saturday, June 20th, at 4:40 P. M. Wartime. Reservations for space should be addressed to Joseph M. Wafer, Chairman, Transportation Committee, in care of Industrial Chemical Sales, 230 Park Avenue, New York.

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3. New 8 page booklet pictures and describes a corrugated pipe shelter with gas tight end walls, emergency escape tunnel and other desirable features. Armco Drainage Products Assn., Middletown, Ohio.

Asphaltic Limestone

5. Characteristics, methods of laying, and results with cold lay mixture shipped ready to use. Especially adapted to resurfacing old pavements, sealcoats and airport runways. Alabama Asphaltic Limestone Co., Liberty Nat. Life Bldg., Birmingham, Ala.

Bridges

7. Teco Connectors, a new method of structural engineering, to spread the load on a timber joint more equally over the cross-section of the wood is described in new literature available from Timber Engineering Co., Inc., Dept. BS-2, 1337 Connecticut Ave., Washington, D. C.

8. A new booklet, "Highway Structures of Douglas Fir," gives up-to-date designs and illustrations of various types of Guard Rails, Culverts, Trestles, Truss Bridges, Arch Bridges and Suspension Bridges built with Douglas Fir. This helpful booklet sent on request by the West Coast Lumbermen's Association, 364 Stuart Bldg., Seattle, Wash.

Cement Dispersion

9. "Economics of Cement Dispersion and Pozzolith" tells the complete story of how cement dispersion reduces water required up to 20% and increases workability 150%. Write The Master Builders Co., Cleveland, Ohio, for a copy.

Cold Mix Plants

10. New catalog and prices of Portable Bituminous Mixers in 6 to 14 ft. sizes for resurfacing and maintenance. Issued by The Jaeger Machine Co., 400 Dublin Ave., Columbus, Ohio.

Concrete Accelerators

31. New 48-page booklet in five sections explains clearly the effects, advantages and methods of using Calcium Chloride and Portland Cement mixes. Complete and packed with practical information; well illustrated; pocket size. Sent free on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

33. Pocket manual of concrete curing with calcium chloride. Complete, handy. Contains useful tables, well illustrated. Write the Columbia Chemical Division, Pittsburgh Plate Glass Co., 30 Rockefeller Plaza, N. Y. C.

Concrete Mixers

44. Catalog and prices of Concrete Mixers, both Tilting and Non-Tilt types, from 3½S to 56S sizes. The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

Concreting in Winter

47. "Build Straight Through the Cold Weather Season" explains briefly how to obtain satisfactory winter concrete in less time. Write Michigan Alkali Co., Ford Bldg., Detroit, Mich.

Drainage Products

70. Standard corrugated pipe, perforated pipe and MULTI PLATE pipe and arches — for culverts, sewers, subdrains, cattlepasses and other uses are described in a 48-page catalog entitled "ARMCO Drainage Products," issued by the Armco Drainage Products Association, Middletown, Ohio, and its associated member companies. Ask for Catalog No. 12.

71. Modern Culvert Practice — a 72 page book containing valuable data and tables will be sent promptly to anyone interested in drainage by Gohi Culvert Mfrs., Inc., Newport, Ky.

73. "Principles of Design of Airport Drainage" and other articles on airport drainage reprinted from PUBLIC WORKS Magazine are being distributed free by Bowerston Shale Co., Bowerston, O., Hancock Brick & Tile Co., Findlay, O., and Columbus Clay Mfg. Co., Blacklick, O. Address anyone of the above for a copy.

Expansion Joints

84. Flexcell cellular expansion joints that compress without extruding and spring back when released are illustrated and described in a new bulletin prepared by The Celotex Corp., 919 No. Michigan Ave., Chicago, Ill.

Graders, Patrol

105. The Austin-Western 99M Power Grader with its powerful all wheel drive simplifies all construction and maintenance; handles difficult jobs with economy and efficiency; and does better work on grading, ditching, scarifying, snow plowing, loading, mixing, bulldozing, shoulder trenching and backsloping. Write for Bulletin 1946. Austin-Western Road Machinery Co., Aurora, Ill.

Mud-Jack Method

107. How the Mud Jack Method for raising concrete curb, gutter, walls and street solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities — a new bulletin by Koehring Company, 3026 West Concordia Ave., Milwaukee, Wis.

Paving Materials, Bituminous

111. An excellent booklet issued by The Barrett Div., 40 Rector St., New York, N. Y., describes and illustrates the uses of each grade of Tarvia and Tarvialithic; 32 good illustrations.

114. Colprovia Paving Process for non-skid pavements include Plant Mixes by both the Heater and Cold Processes, Road Mix Process and Surface Treatment Process. New literature covering these processes is available from Colprovia Roads, Inc., 183 East Main St., Rochester, N. Y.

Paving Materials, Brick

116. "New Developments in Brick Pavements." A review of the developments in brick pavements in recent years. Issued by the National Paving Brick Association, National Press Building, Washingon, D. C.

Pumps

120. Interesting new booklet tells how to lengthen the life of your pumps. Explains how a little care will save a lot of wear. Write today for your copy. Homelite Corp., 2403 Riverdale Ave., Portchester, N. Y.

121. New illustrated catalog and prices of Jaeger Sure Prime Pumps, 2" to 10" sizes, 7000 to 220,000 G.P.H. capacities, also Jetting, Caisson, Road Pumps, recently issued by The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

123. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting pumps, well point pumps, triplex road pumps and the lightweight pumps.

124. 16-page illustrated bulletin, SP-37, describes and illustrates complete C. H. & E. line of self-priming centrifugal pumps from ½" to 8", including lightweight models for easy portability. C. H. & E. Mfg. Co., 3841 No. Palmer St., Milwaukee, Wis.

Retaining Walls

126. Charts showing the design of cellular or bin-type metal retaining walls, helpful suggestions on their use for stabilizing slopes, preventing stream encroachment, and solving problems of limited right of way, and construction details are given in a 16-page bulletin entitled, "ARMCO Bin-Type Retaining Walls." It is published by the Armco Drainage Products Association, Middletown, Ohio, and member companies. Ask for Bulletin H-37.

Road Building and Maintenance

128. Motor Patrol Graders for road maintenance, road widening and road building, a complete line offering choice of weight, power, final drive and special equipment to exactly fit the job. Action pictures and full details are in catalogs Nos. 253, 254 & 255, issued by Galion Iron Works & Mfg. Co., Galion, Ohio.

129. New bulletins illustrate and describe the latest line of Littleford Utility Spray Tanks, Street Marking Units, Street Flushers and Kettles. Littleford Bros., 453 East Pearl St., Cincinnati, Ohio.

Rollers

133. New Tu-Ton roller of simple construction for use in rolling sidewalks along highways, playgrounds and other types of light rolling is fully described in a bulletin issued by C. H. & E. Mfg. Co., 3841 No. Palmer St., Milwaukee, Wis.

138. "The Buffalo-Springfield line of road rollers (tandem, 3-wheel, and 3-axle) are described in the latest catalog issued by the Buffalo-Springfield Roller Co., Springfield, Ohio."

139. "Ironeroller" 3 Axle Roller for extra smooth surfaces on all bituminous work. Booklet contains roller data and operation details. Hercules Co., Marion, Ohio.

Soil Stabilization

150. "High-Service, Low Cost Roads" is one of the newer booklets using an effective combination of picture and text to set forth the principals and advantages of road surface stabilization with calcium chloride. Complete, interesting and well illustrated. 34 pages. Sent by Solvay Sales Corp., 40 Rector St., New York, N. Y.

152. The Columbia Alkali Corporation, will be glad to furnish to anyone interested complete information dealing with Calcium Chloride Stabilized Roads. This literature contains many charts, tables and useful information and can be obtained by writing Columbia Alkali Div., Pittsburgh Plate Glass Co., 30 Rockefeller Plaza, New York City.

154. "Soil Stabilization with Tarvia" —An illustrated booklet describing The steps in the stabilization of roadway soil with Tarvia will be mailed on request by

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Readers' Service Department

(*Continued from page 55*)

The Barrett Company, 40 Rector St., New York, N. Y.

Spreader

147. Jaeger Paving equipment, including Mix-in-Place Roadbuilders, Bituminous Pavers, Concrete Bituminous Finishers, Adjustable Spreaders, Forms, etc.—4 complete catalogs of latest equipment in one cover, issued by The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

Street and Paving Maintenance

Asphalt Heaters

198. Illustrated Bulletins 15 to 20 describe Mohawk Oil Burning Torches; "Hotstuf" Tar and Asphalt Heaters; Portable Trailer Tool Boxes; Pouring Pots and other equipment for street and highway maintenance, roofing, pipe coating, water proofing, etc. Mohawk Asphalt Heater Co., Frankfort, N. Y.

Snow Fighting

Plows

350. "Frink One-Way Sno-Plows" is a four page catalog illustrating and describing 5 models of One-Way Blade Type Sno-Plows for motor trucks from 1½ up to 8 tons capacity. Interchangeable with V Sno-Plow. Features, specifications and method of attaching. Carl H. Frink, Mfr., Clayton, 1000 Islands, N. Y.

Ice Control

351. "Make Icy Highways Safe for Traffic"—a new bulletin by Michigan Alkali Co., Ford Bldg., Detroit, Mich., tells how to use calcium chloride for modern ice control.

Sanitary Engineering

Activated Alum

354. "Technical Data on Activated Alum and Dustless Blackalum" points out the analytical side of Activated Alum and Blackalum. Write Stuart-Brumley Corp., 516 No. Charles St., Baltimore, Md.

Aero-Filter

356. "Results Produced by Aero-Filters" is a new pamphlet covering results at Temple, Texas; Paris, Ill.; Webster City, Iowa; and Mason, Mich. Write Lakeside Engineering Corp., 222 West Adams St., Chicago, Ill.

Air Release Valves

357. Automatic Air Release Valves for water, sewage and industrial uses are described and illustrated in new catalog issued by Simplex Valve & Meter Co., 6750 Upland St., Philadelphia, Pa.

Analysis of Water

360. "Methods of Analyzing Water for Municipal and Industrial Use" is an excellent 94 page booklet with many useful tables and formulas. Sent on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

Activation and Aeration

376. A valuable booklet on porous diffuser plates and tubes for sewage treatment plants. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability. 20pp. illustrated. Sent on request to Norton Company, Worcester, Mass.

Cleaning Sewers

383. A 20-page booklet describes and illustrates a full line of sewer cleaning equipment—Rods, Root Cutters, Buckets, Nozzles and Flushers. Write W. H. Stewart (Pioneer Mfr. since 1901), Jacksonville, Fla., or P. O. Box 767, Syracuse, N. Y.

384. A new 32-page, illustrated booklet explains how a city can clean its sewers and culverts with its own forces using the up-to-date Flexible Sewer Rod equipment. Illustrates and describes all necessary equipment. Issued by Flexible Sewer Rod Equipment Co., 9059 Venice Boul., Los Angeles, Calif.

Consulting Engineers

385. "Who, What, Why" outlines briefly the functions of the consulting chemist and chemical engineer. Covers various methods of cooperation, on different types of problems, with industry, with attorneys and with individuals. Foster D. Snell, Inc., 305 Washington St., Brooklyn, N. Y., will send a copy on request.

Feeders, Chlorine, Amonia and Chemical

387. For chlorinating water supplies, sewage plants, swimming pools and feeding practically any chemical used in sanitation treatment of water and sewage. Flow of water controls dosage of chemical; reagent feed is immediately adjustable. Starts and stops automatically. Literature from % Proportioneers, Inc. % 96 Codding St., Providence, R. I.

Filter Bed Agitator

388. 60-page booklet, "The Mechanics of Filter Bed Agitation," containing engineering data, technical information concerning surface wash and opinions of users will be sent promptly by Stuart-Brumley Corp., 516 No. Charles St., Baltimore, Md.

Fire Hydrants

390. Specifications for standard AWWA fire hydrants with helpful instructions for ordering, installing, repairing, lengthening and using. Issued by M. & H. Valve & Fittings Co., Anniston, Ala.

391. See listing No. 410.

Flow Meters

393. The primary devices for flow measurement—the orifice, the pilot tube, the venturi meter and others — and the application to them of the Simplex meter are described in a useful 24-page booklet (42A). Simplex Valve and Meter Co., 6750 Upland St., Philadelphia, Pa.

Gates, Valves, Hydrants

394. Gate, flap and check valves; floor stands and fittings. New catalog No. 34 gives detail information with dimensions for all types of new full line. M. & H. Valve & Fittings Co., Anniston, Ala.

395. Complete booklet with much worthwhile water works data describes fully Ludlow hydrants and valves. Sent on request. Ludlow Valve Mfg. Co., Troy, N. Y.

396. See listing No. 410.

Gauges

398. The full line of Simplex gauges for filtration plants are illustrated and described in catalog issued by Simplex Valve and Meter Co., 6750 Upland St., Philadelphia, Pa.

Hypochlorinators

400. New illustrated booklet W&T 357 describes this simple, inexpensive means of protecting small water supplies such as summer camps, hotels, swimming pools, dairies, etc., as well as for feeding chemical solutions in the water works plant. Contains typical installation sketches. Write "Wallace & Tiernan Co., Inc., Newark, N. J.

Manhole Covers and Inlets

402. Street, sewer and water castings in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., Lafayette Boul. and Indiana Ave.. South Bend, Ind.

Meters, Venturi

406. New bulletin illustrates Builders Air Relay system of transmission for the Venturi Meter which is particularly useful for liquids containing suspended solids like sewage. Eliminates corroson, clogged pipes, etc. Write Builders-Providence, Inc., Codding St., Providence, R. I.

Pipe, Cast Iron

408. Handbook of Universal Cast Iron Pipe and Fittings, pocket size, 104 pages, illustrated, including 14 pages of useful reference tables and data. Sent by The Central Foundry Co., 386 Fourth Ave., New York, N. Y.

409. Cast iron pipe and fittings for water, gas, sewer and industrial service. Super-deLavaud centrifugally-cast and pit-cast pipe. Bell-and-spigot, U. S. Joint, flanged or flexible joints can be furnished to suit requirements. Write U. S. Pipe and Foundry Co., Burlington, N. J.

410. "Cast Iron Pipe and Fittings" is a well illustrated 44 page catalog giving full specifications for their complete line of Sand Spun Centrifugal Pipe, Fire Hydrants, Gate Valves, Special Castings, etc. Will be sent promptly by R. D. Wood Co., 400 Chestnut St., Philadelphia, Pa.

Pipe Forms

411. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pipe, Reinforced Concrete

412. Literature describing the manufacture and installaton of Lock Joint Reinforced Concrete Pressure Pipe for water supply lines and sewer force mains. Lock Joint Pipe Co., Ampere, N. J.

Pipe Repair Materials

413. Repair clamps and saddles for steel and cast iron pipe; pipe line clamps; pipe joint clamps and many other handy and economical tools for the water works man. Catalog 41. M. B. Skinner Company, South Bend, Ind.

Pipe, Transite

414. Two new illustrated booklets, "Tansite Pressure Pipe" and "Transite Sewer Pipe" deal with methods of cutting costs of installation and maintenance of pipe lines and summarize advantages resulting from use of Transite pipes. Sent promptly by Johns-Manville Corp., 22 East 40th St., New York, N. Y.

Pipe Joints, Sewer

415. How to make a perfect sewer pipe joint—tight, prevents roots entering sewer, keeps lengths perfectly aligned; can be laid with water in trench or pipe. General instructions issued by L. A. Weston, Adams, Mass.

Pumps and Well Water Systems

420. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklets. Advertising Dept., Layne & Bowler, Inc., Box 186, Hollywood Station, Memphis, Tenn.

Meter Setting and Testing

430. The most complete catalog we have seen on setting and testing equipment for water meters—exquisitely printed and illustrated 48-page booklet you should have a copy of. Ask Ford Meter Box Co., Wabash, Ind.

Reservoirs, Concrete

431. Data on how large reservoirs may be built at a saving as units by the

Wm. S. Hewett System of reinforced concrete construction will be sent without obligation. The Wm. S. Hewett System, 20 N. Wacker Dr., Chicago, Ill.

434. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straightline Bar Screens" (Vertical and Inclined types). Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill.

Sewers

437. "ARMCO Sewers" is the title of a 48-page booklet describing the structural and other advantages of ARMCO Ingot Iron. Paved Invert and Asbestos-Bonded pipe for storm and sanitary sewers. Design data and large charts will be found helpful by engineers engaged in the design or construction of sewers. Copies will be sent on request by the Armco Drainage Products Association, Middletown, Ohio, or its associated member companies.

Sludge Drying and Incineration

440. "Disposal of Municipal Refuse." Complete specifications and description including suggested form of proposal; form of guarantees; statements and approval sheet for comparing bids with diagramatic outline of various plant designs. 48 pages. Address: Morse Boulger Destructor Co., 216-P East 45th St., New York, N. Y.

442. Recuperator tubes made from Silicon Carbide and "Fireclay" Corebusters for maximum efficiency are described and illustrated in bulletin No. 11 issued by Fitch Recuperator Co., Plainfield National Bank Bldg., Plainfield, N. J.

Softening

444. This folder explains the process of Zeolite water softening and describes and illustrates the full line of equipment for that purpose made by the Graver Tank & Mfg. Co., 4809-15 Tod Ave., East Chicago, Ind. Write for a copy of this instructive folder.

Sprinkling Filters

445. Design data on sprinkling filters of Separate Nozzle Field and Common Nozzle Field design as well as complete data on single and twin dosing tanks, and the various siphons used in them, for apportioning sewage to nozzles. Many time-saving charts and tables. Write Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill.

Swimming Pools

446. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

447. 40-page Manual on swimming pools. Includes swimming and pool layouts, specifications, etc., and details concerning Permutit Swimming Pool Equipment. Write The Permutit Co., Dept. G-4, 330 West 42 St., New York, N. Y.

Taste and Odor Control

450. Technical pub. No. 207 issued by Wallace & Tiernan Co., Inc., Newark, N. J., describes in detail taste and odor control of water with BREAK-POINT Chlorination, a method of discovering the point at which many causes of taste may be removed by chlorination with little or no increase in residual chlorine. Sent free to any operator requesting it.

Treatment

453. "Safe Sanitation for a Nation," an interesting booklet containing thumbnail descriptions of the different pieces of P.F.T. equipment for sewage treatment. Includes photos of various installations and complete list of literature available from this company. Write Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill.

455. New booklet (No. 1642 on Link-Belt Circuline Collectors for Settling Tanks contains excellent pictures; drawings of installations, sanitary engineering data and design details. Link-Belt Company, 2045 W. Hunting Park Ave., Philadelphia.

456. New 16-page illustrated catalog No. 1742 on Straightline Collectors for the efficient, continuous removal of sludge from rectangular tanks at sewarage and water plants. Contains layout drawings, installation pictures, and capacity tables. Address Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia, Pa.

457. New illustrated folder (1942) on Straightline apparatus for the removal and washing of grit and detritus from rectangular grit chambers. Address: Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.

458. "Sedimentation with Dorr Clarifiers" is a complete 36-page illustrated catalog with useful design data. Ask The Dorr Company, 570 Lexington Ave., New York, N. Y.

459. A combination mechanical clarifier and mechanical digester, The Dorr Clarigester, is explained and illustrated in a bulletin issued by The Dorr Company, 570 Lexington Ave., New York, N. Y.

461. Prefiocculation without chemicals with the Dorrco Clarifiocculator in a single structure is the subject of a new booklet issued by The Dorr Company, 570 Lexington Ave., New York, N. Y.

462. Dorrco Monorake for existing rectangular sedimentation tanks, open or closed, is described and illustrated in a new catalog sent on request. The Dorr Co., 570 Lexington Ave., New York, N. Y.

Tunnel Liners

480. "Save Money with Armco *Light Duty* Tunnel Liner" is a bulletin you'll want if you are interested in economical, long lasting tunnels. Write Armco Drainage Products Assn., Middletown, Ohio.

Valves (See Gates, Air Release, etc.)

Water Works Operating Practices

490. "Important Factors in Coagulation" is an excellent review with bibliography and outlines of latest work done in the field. Written by Burton W. Graham and sent free on request to Stuart-Brumley Corp., 516 No. Charles St., Baltimore, Md.

Water Service Devices

500. Data on anti-freeze outdoor drinking fountains, hydrants, street washers, etc., will be sent promptly on request to Murdock Mfg. & Supply Co., 426 Plum St., Cincinnati, Ohio.

PEOPLE *Here and There*

Conventions and Association Meetings

April 2-4. Fifth Annual Short Water Course at University of Missouri, Columbia, Mo.

May 27 and 28. New England Sewage Works Assn. annual meeting at Hotel Bradford, Boston, Mass. LeRoy W. VanKleeck, Secty.

June 21-25. American Water Works Assn. annual meeting at Stevens Hotel, Chicago, Ill. Harry E. Jordan, Secty.

New Appointments

New city officials recently appointed:

City Engineers

Clayton W. Paige, Burbank, Calif.
Kenneth H. Holmes, New London, Conn.
B. F. Craig, DeLand, Fla.
P. T. Naylor, Hastings, Nebr.
Robert Wager, Bellevue, Ohio.
C. R. Bricker, Warren, Ohio.
Anton E. Bauer, Farrell, Pa.
Griff W. Nicholls, Sharon, Pa.
P. R. Rosen, Aberdeen, Wash.
L. W. Collins, Clarksburg, W. Va.

City Managers

Oren L. King, Montrose, Colo.
John W. Sheedy, New London, Conn.

Supt. Public Works

George G. Hyland, Boston, Mass.
Carl C. Lanford, Greer, S. C.

Water Works Superintendents

John P. Moriarty, Monson, Mass.
Leo H. Martin, Ogallala, Nebr.
Frank Marshall, Media, Pa.

County Engineers

Fred F. Tate, Monroe Co., Albia, Iowa.
J. A. Rowat, Emmett Co., Esthersville, Iowa.
H. R. George, Clarke Co., Osceola, Iowa.
Orville T. Upp, Wapello Co., Ottumwa, Iowa.
H. L. Parker, Doniphan Co., Troy, Kan.
Linus Roth, Trego Co., Wakeeney, Kan.
B. W. May, Simpson Co., Mendenhall, Miss.
Edgar Rapp, Jr., St. Charles Co., St. Charles, Mo.
G. C. Travis, Belmont Co., St. Clairsville, Ohio.
Bert Carver, Marshall Co., Britton, S. D.
Charles Dwyer, Monroe Co., Sparta, Wis.

Mr. Amiel Reichstein, former city engineer at Fairfield, Iowa, is now with Constructing Quartermaster, Dept. Training Center, Rio Hato, Republic of Panama.

Alan D. Drake, for the past year Senior Engineer, Airport Section, Engr. Branch, Corps of Engrs., U. S. Army, has returned to his old position as Director of Water, Buffalo, N. Y.

M. W. Tatlock Appointed Engineer Aide at Cantonment

Loaned to the war department for at least six months, M. W. Tatlock, superintendent of the Dayton, Ohio, sewage treatment plant, is assistant chief engineer of a $40,000,000 army cantonment to house 40,000 soldiers at Columbus, Ind.

ADVERTISERS
IN THIS ISSUE